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Threading Tool and Gage Forms for the New Screw Thread Standard

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Shape of cutting edges for threading tools and taps—Proper outlines for gage points—Preparation of charts for inspection by optical projection—The Hartness Comparator

IN A series of articles published in Vol. 59 of the *American Machinist*, the writer described and explained the new American National Screw Thread Standards. Since that time these Standards have been subjected to further minor revisions which, however, do not affect interchangeability, and they have as a whole been officially adopted by the National Screw Thread Commission, the American Engineering Standards Committee, the Society of Automotive Engineers and the American Society of Mechanical Engineers. Such parts as are applicable to their work have also been accepted by large numbers of other organizations and individual users, such as the Tap and Die Institute, the Machine Screw Manufacturers, the General Motors Corporation, etc. The Standards may therefore be considered as established so far as official action can make them so.

To assist in bringing them into still more general use the writer presents the following supplementary information on the tooth form of threading tools and gages. A portion of this material was prepared for a forthcoming report of the National Screw Thread Commission.

Screws, or external threads, may be cut by lathe tools, solid or adjustable dies, adjustable or opening dieheads with removable chasers, thread milling cutters, threading hobs and thread rolling dies. Of these the dies, diehead chasers, hobs and rolling dies are all multiple-threaded, and form several thread spaces simultaneously, finishing the operation at one pass. Lathe tools are ordinarily single pointed and operate in a single thread, that is finished by repeated passes, but multiple-tool chasers for use as lathe tools are sometimes made.

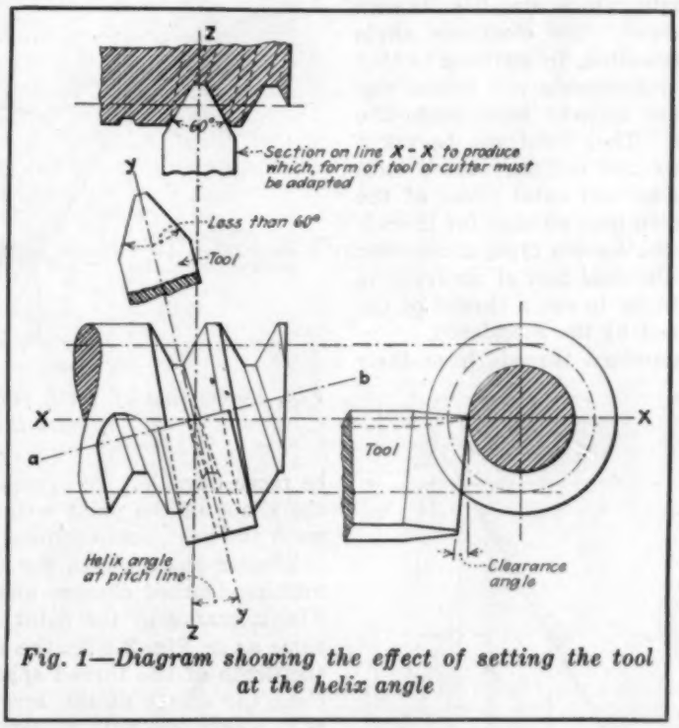

Fig. 1—Diagram showing the effect of setting the tool at the helix angle

All threading tools, whether for use in lathe, diehead, thread miller or thread roller, and whether single- or multiple-pointed, must cut the proper tooth shape on an axial section of the work. In Fig. 1, for instance, the lathe threading tool is shown tipped up to the helix angle of the thread to be cut. This is, sometimes done for the sake of better cutting action. The effect is to necessitate a change in the tool shape, which must show an included angle of less than 60 deg. when projected on line *y-y* of the illustration if the angle of the resulting thread, as measured on the axial section *x-x*, is to be exactly 60 deg. When the ordinary thread milling cutter is set at the helix angle, it must also have the same correction if accurate results are desired.

The plane *a-b*, however, projected on line *y-y*, is not

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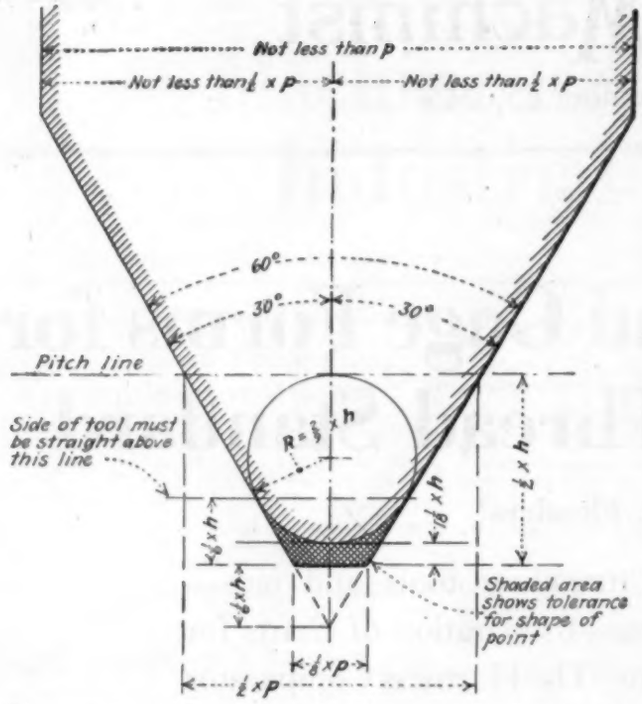


Fig. 2—Shape of single-point tool not intended to trim the crest of thread

the most convenient one on which to measure the tool shape during its manufacture, because it is away from the perpendicular to the front edge of the tool by the amount of the clearance angle, which also has its own slight effect on the tool shape. The clearance angle thus requires its own compensation, in addition to that for the helix angle. These refinements will not be discussed here, since they have already been made the subject of previous articles. They need not be taken into account in making taps and ordinary lathe tools that are gaged throughout on the axial plane of the work, but they should be taken into account for thread-rolling dies and chasers of the Landis type, if accurate work is desired. In brief, the final test of accuracy in any threading tool is the ability to cut a thread of the proper axial section as defined by the Standards.

Most cutting tools for standard threads have their

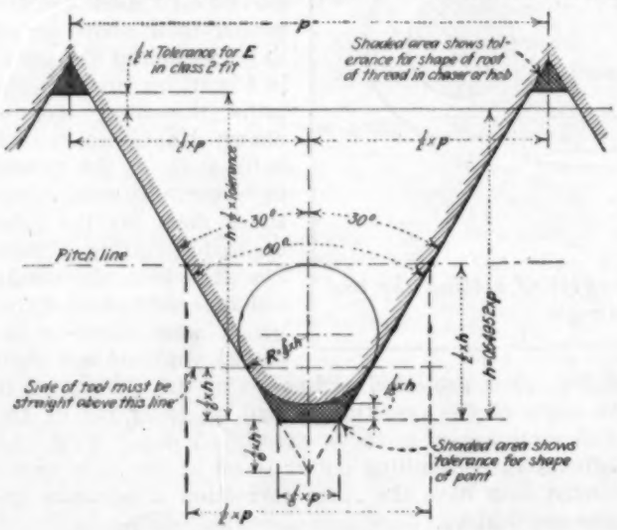

p
⅛ x Tolerance for E in class 2 fit
Shaded area shows tolerance for shape of root of thread in chaser or hob
⅛ x p
½ x p
h = ½ x Tolerance
30°
30°
60°
Pitch line
R = ⅛ h
h = .64952 p
Side of tool must be straight above this line
⅛ x h
½ x h
⅛ x h
⅛ x h
Shaded area shows tolerance for shape of point
⅛ x p
½ x p

Fig. 3—Outline of chaser or hob not intended to trim the crest of thread

cutting edges in the axial plane of the work, so that the shape of those edges tends to reproduce itself on the screw thread. In forming and inspecting the cutting edges of these tools, their forms may be directly compared with the standard outlines. This can be done by means of accurately formed templets, carefully applied under the microscope. A more satisfactory and practical way, however, is to draw the desired outline on a chart, magnified 100 or 200 times, and then project on this chart the image of the cutting tool under inspection magnified to the corresponding degree. By this means the tool shape may be quickly compared with the standard shape to a degree of accuracy much greater than that required for commercial work. Care must be taken to use a lens system free from distortion. Optical projection machines and comparators are available for this work in commercial designs.

In Fig. 2 is shown the form of outline required for a single point lathe tool or a milling cutter as measured on the axial section of the work. This diagram, if drawn to a magnification of 100 or 200 times, will serve as a chart for projection testing. Note the shaded area at the point of the tool, within which a tool point of any shape is permissible. While sharp cornered tools are easier to make, one with a permissible round might

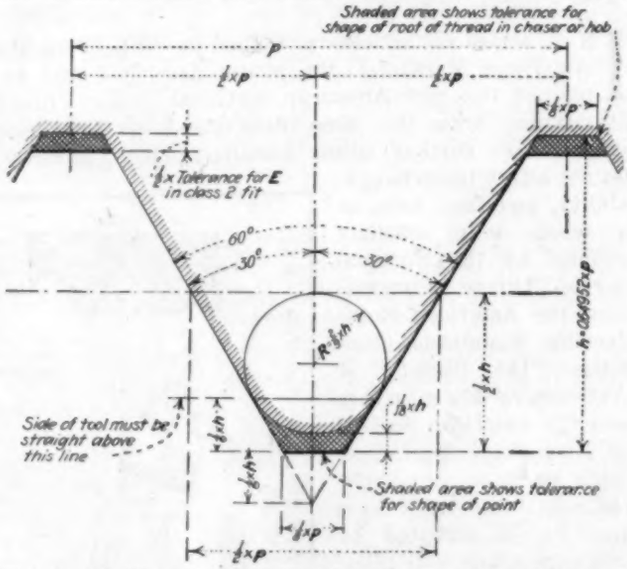

Shaded area shows tolerance for shape of root of thread in chaser or hob
p
½ x p
½ x p
⅛ x p
⅛ x Tolerance for E in class 2 fit
60°
30°
30°
R = ⅛ h
h = .64952 p
⅛ x h
½ x h
Side of tool must be straight above this line
⅛ x h
⅛ x h
Shaded area shows tolerance for shape of point
⅛ x p
½ x p

Fig. 4—Outline of teeth for chaser or hob which will trim the crest

be more durable. In general it will be proper to keep the shape of the point well away from both the maximum and minimum outlines.

Similar instructions for determining the outline of multiple-toothed chasers and hobs are given in Fig. 3. The tolerance at the point of crest of the tool is the same as in Fig. 2. At the roots of the teeth, however, the depth of the thread space is carried far enough to clear the crests of the screw thread being cut. This is in accordance with modern practice in threading alloy steels which tend to tear at the crests. Relieving the chasers as shown minimizes this trouble.

It should be noted that this clearance at the crest of the screw, as dimensioned, is certain only on Class II, III and IV fits. If a Class I screw is being cut from stock of maximum major diameter size to a minimum pitch diameter, the crests will be trimmed by the chaser. It is not possible to avoid this without cutting the

thread spaces in the chasers nearer to a sharp bottom than is desirable.

When it is desired to follow the older practice and permit trimming of the crests, the outline shown in Fig. 4 may be used. It is somewhat easier to make than the one shown in Fig. 3. Note that the tolerance allowed for the shape of the points or crests in Figs. 3 and 4 is the same as in Fig. 2, and the same remarks apply. In both Figs. 3 and 4 the shape of the bottom of the thread spaces may be given any curved form which can be contained within the shaded tolerance area, and still produce screw threads which will agree with the standards. The required dimensions for drawing the charts of Figs. 2, 3 and 4 correctly for any standard pitch will be found in the accompanying table.

The form of outline, measured on the axial section of the work, required in a tap or other internal threading tool for cutting threads to the new standards is shown in Fig. 5. These are the same for all pitches and

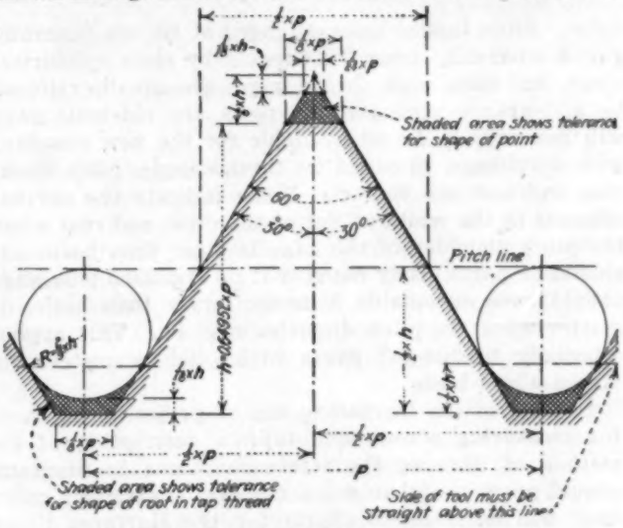

Shaded area shows tolerance for shape of point
60°
30°
30°
Pitch line
Shaded area shows tolerance for shape of root in tap thread
Side of tool must be straight above this line

Fig. 5—Tooth shape for tap or internal thread-chasing tool

classes of fit. This diagram, if drawn to a magnification of 100 or 200 times, will serve as a chart for projection testing. Note the shaded area at the point of the tool, within which a tool point of any shape is permissible. While sharp-cornered tools are easier to make, one with a round might be more durable.

In any event the maker of the tap or other tool should keep the outline well away from the lower part of the permissible area. The danger here is that after a few

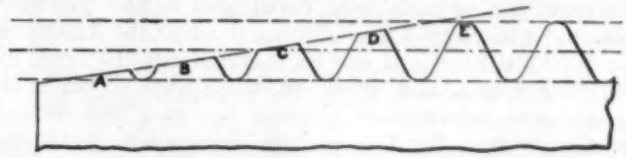


Fig. 6—Sharp and rounded cutting points on Whitworth tap or die

holes have been tapped the corners will be rounded over so that the tapped hole rejects the basic gage. The shaded area at the root of the thread shows the permissible variation in tooth outline at this point. The table gives the necessary dimensions for drawing the diagram shown in Fig. 5 for any standard pitch.

Reference was made above to the advisability of rounded points or crests on taps, chasers and threading tools within the limits allowed by the new standards. This practice would increase the difficulty of manufacture of these tools, but would doubtless lead to a somewhat greater durability of cutting edge. It should be carefully noted, however, that this increase of durability is not as great as might at first thought be expected.

An outline of the cutting edge of a Whitworth tap or die is shown in Fig. 6, in which the principle of rounded crests and roots is consistently carried out. Observe that practically all of the stock is removed by cutting points *A*, *B*, *C* and *D*, which have sharp corners given by the chamfer. These corners are as much subjected to wear as the corresponding ones of an ordinary

Table of Dimensions of Various Thread Elements for Drawing Charts

Threads per Inch = n	Pitch = p	½ × p	¼ × p	⅛ × p	1/24 × P	Depth of Thread = h	⅝ × h	½ × h	⅜ × h	R = ⅛ × h	¼ × h	1/16 × h	⅛ Tolerance For E-Class 2 Fit	h + ⅛ Tol.
80	.01250	.00625	.00312	.00156	.00052	.00812	.00677	.00406	.00271	.00180	.00135	.00045	.00085	.00897
72	.01389	.00695	.00347	.00174	.00058	.00902	.00752	.00451	.00301	.00200	.00150	.00050	.00090	.00992
64	.01562	.00781	.00390	.00195	.00065	.01014	.00845	.00507	.00338	.00225	.00169	.00056	.00095	.01109
56	.01786	.00893	.00446	.00223	.00074	.01160	.00967	.00580	.00387	.00258	.00193	.00064	.00100	.01260
48	.02083	.01042	.00521	.00260	.00087	.01353	.01127	.00676	.00451	.00301	.00225	.00075	.00110	.01463
44	.02273	.01136	.00568	.00284	.00094	.01476	.01230	.00738	.00492	.00328	.00246	.00082	.00115	.01591
40	.02500	.01250	.00625	.00313	.00104	.01624	.01353	.00812	.00541	.00361	.00271	.00090	.00120	.01744
36	.02778	.01389	.00694	.00347	.00116	.01804	.01503	.00902	.00601	.00401	.00301	.00100	.00125	.01929
32	.03125	.01562	.00781	.00391	.00130	.02030	.01692	.01015	.00677	.00451	.00338	.00113	.00135	.02165
28	.03571	.01786	.00893	.00446	.00149	.02319	.01933	.01160	.00773	.00516	.00386	.00129	.00155	.02474
24	.04167	.02083	.01042	.00521	.00174	.02706	.02255	.01353	.00902	.00602	.00451	.00150	.00165	.02871
20	.05000	.02500	.01250	.00625	.00208	.03248	.02707	.01624	.01083	.00722	.00541	.00180	.00180	.03428
18	.05556	.02778	.01389	.00694	.00232	.03608	.03007	.01804	.01203	.00802	.00601	.00200	.00205	.03813
16	.06250	.03125	.01562	.00781	.00260	.04060	.03383	.02030	.01353	.00902	.00677	.00226	.00225	.04285
14	.07143	.03571	.01786	.00893	.00298	.04640	.03867	.02320	.01547	.01031	.00773	.00257	.00245	.04885
13	.07692	.03846	.01923	.00962	.00320	.04996	.04163	.02498	.01665	.01110	.00833	.00278	.00260	.05256
12	.08333	.04167	.02083	.01042	.00347	.05413	.04511	.02706	.01804	.01203	.00902	.00301	.00280	.05693
11	.09091	.04545	.02273	.01136	.00379	.05905	.04921	.02952	.01968	.01312	.00984	.00328	.00295	.06200
10	.10000	.05000	.02500	.01250	.00417	.06495	.05412	.03248	.02165	.01443	.01082	.00361	.00320	.06815
9	.11111	.05556	.02778	.01389	.00463	.07217	.06013	.03608	.02406	.01604	.01203	.00401	.00350	.07567
8	.12500	.06250	.03125	.01562	.00521	.08119	.06766	.04060	.02706	.01804	.01353	.00451	.00380	.08499
7	.14286	.07143	.03571	.01786	.00595	.09279	.07732	.04640	.03093	.02062	.01546	.06516	.00425	.09704
6	.16667	.08333	.04167	.02086	.00694	.10825	.09021	.05413	.03608	.02405	.01804	.00602	.00505	.11303
5	.20000	.10000	.05000	.02500	.00833	.12990	.10825	.06495	.04330	.02887	.02165	.00722	.00508	.13498
4½	.22222	.11111	.05556	.02778	.00926	.14434	.12028	.07217	.04811	.03208	.02406	.00802	.00635	.15069
4	.25000	.12500	.06250	.03125	.01042	.16238	.13531	.08119	.05413	.03608	.02706	.00902	.00700	.16938

U. S. S. tap or die. It is only on the final or finishing tooth *E* that the rounded outline is effective. Here it has the undoubted advantage of tending to preserve the final form of the teeth, whatever the wear of the preceding cutting edges may have been.

The first and most important step in the manufacture of threaded parts to the new standard is the provision of proper gages. Otherwise work which is standard will be rejected. Fig. 7 shows the thread outline which external gaging tools must be adapted to fit. The first step to be taken by a firm wishing to adopt the American or National Standard will be to grind out the holes of all ring gages, and grind off the points of all snap gages and micrometer calipers, to pass the outline shown in Fig. 7. The various dimensions given are shown for all standard pitches in the table.

Plug gages for measuring standard holes must pass the outlines shown in Fig. 8. The principal change in the new tapped hole is the provision for larger tap drills. Since tapped holes, if gaged at all, are generally gaged separately from the threads by plain cylindrical plugs, and since male thread gages are usually relieved by a clearance groove at the roots, the old male gage will generally be found available for the new standard without change, provided its thread angle, pitch diameter and lead are correct. Notes indicate the obvious changes in the width of flat at the crest and root when the pitch diameter of the gage is other than basic. It should be particularly noted that no standard plug gage should have an outside diameter larger than basic, no matter what the pitch diameter may be. This applies especially to "no-go" gages with pitch diameters enlarged above basic.

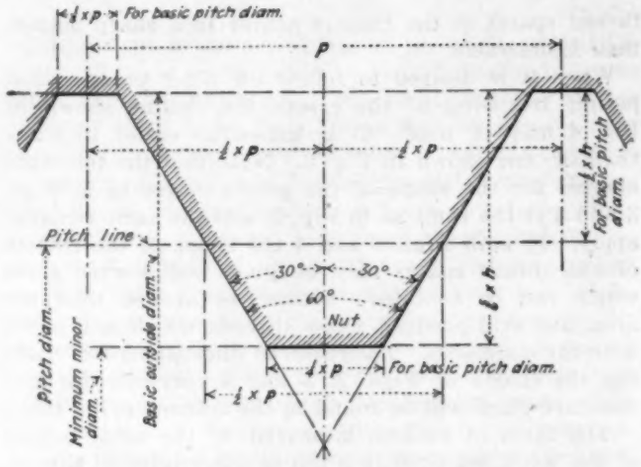


Fig. 8—Thread outline in nut that must be passed by plug gage

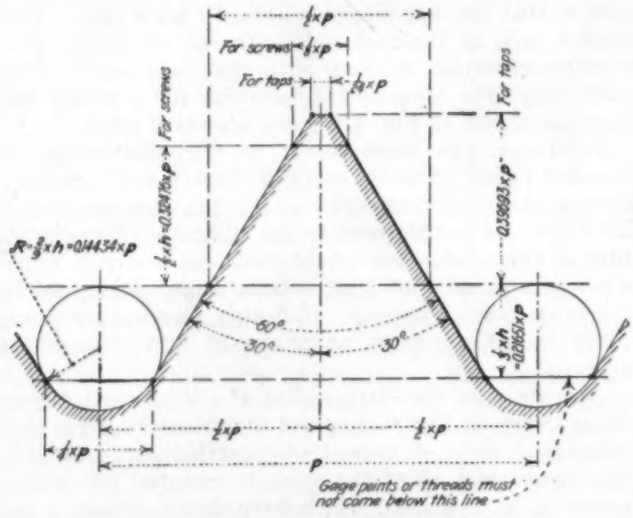


Fig. 7—Profile to be cleared by ring and snap gages, etc.

In view of the increasing use of projection methods for measuring screws and taps, a description of the method of drawing the reference charts or diagrams should prove useful to many readers. Particular reference will be made to charts for the Hartness Screw Thread Comparator. This information is here made public for the first time. In Fig. 9 a screw is shown mounted in the cradles on the stage of the comparator, and also the resulting image on the chart. Cradle *A* is fixed. Cradle *B* is free to slide. Thread *C* is the one whose image is thrown on the chart. Since the work is supported on the flanks of the threads, the image will be raised if the pitch diameter is large, and lowered if it is small. Since the work is confined longitudinally by the fixed threaded cradle at the left of the thread being projected, the image will move to the right if the lead is long, and to the left if the lead is short. If changes in both lead and pitch diameters occur in a piece, they will show in the form of a shift in the image both horizontally and vertically.

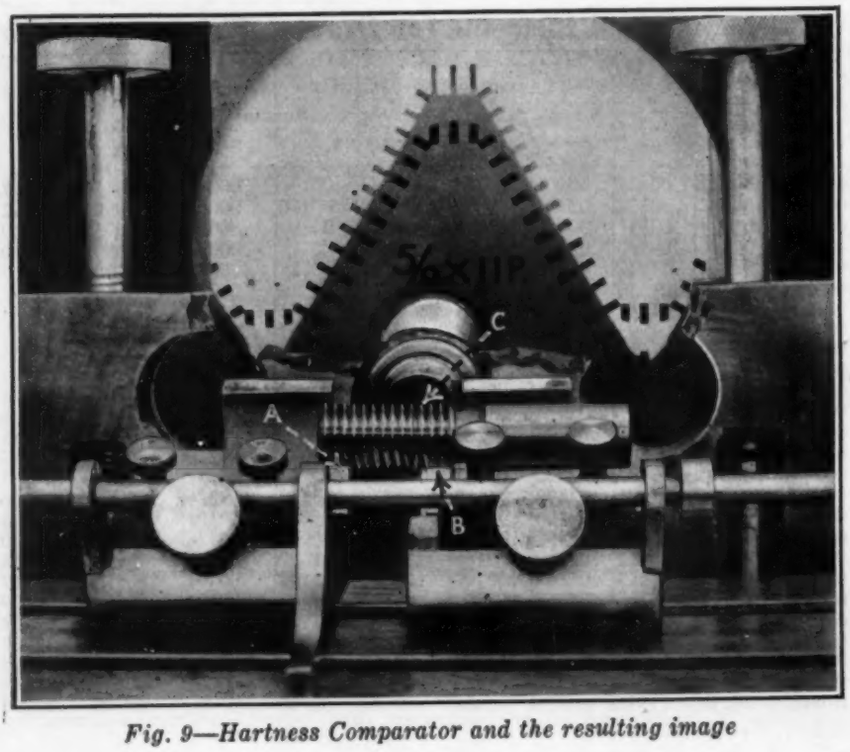


Fig. 9—Hartness Comparator and the resulting image

All this is perhaps more clearly seen in the diagrammatical representation of Fig. 10, where the full line represents a piece of work or a plug gage of accurate basic dimensions, while the dotted lines show the effect of replacing it with a screw of smaller pitch diameter and shorter lead. The circle represents the objective lens of the

projecting microscope. A chart of the kind used in this instrument is shown in Fig. 11, and the image of the basic plug (shown by the full lines in Fig. 10) has been thrown upon it. The chart and image were then adjusted until this basic outline matched the inner edge of the upper row of blocks. In other words, this outline was matched with the maximum tolerance allowed by the chart. In Fig. 12 is shown, but with less exaggeration,

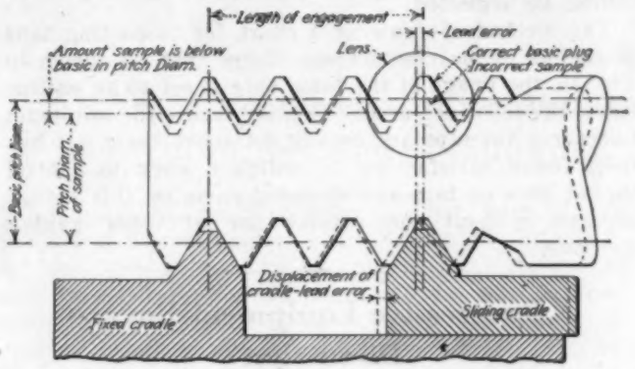


Fig. 10—How variations in lead and pitch diameter affect the image

the result of throwing on this same chart the image of the small, short-lead screw indicated by the dotted lines of Fig. 10. Fig. 13 illustrates an image of a screw so far out in lead and pitch diameter that it comes outside of the tolerance area, and is therefore unacceptable. A comparison of the five illustrations, Figs. 9 to 13, will do more than words can to demonstrate the relationship between gage, work, image and chart.

What may not be so clear is this: If the fixed cradle is set away from the axis of the lens system by an amount equal to the length of engagement (see Fig. 10) which the screw being tested is to have in service, then the vertical and horizontal displacements of the image within the tolerance area of the chart will show the combined effect of lead and diameter errors on the fit in actual service.

Let us now proceed to the actual drawing of the chart. This is drawn up in accordance with the dimensions given in Fig. 14, with outlines based on the new screw thread standard. The use of blocks instead of lines for the outlines enclosing the tolerance area is a device which has been found useful from the optical standpoint. The image is more easily compared by the eye if matched with the edges of these blocks than if matched with a continuous line. The depth of the blocks is immaterial.

The relationship between lead and pitch diameter errors on the one hand, and the tolerance area of the chart on the other, is absolute in predicting an interference. If the comparator is set up as shown in Figs. 9 and 10, with the length of engagement properly adjusted, the screw whose image overlaps the outer boundary of the tolerance area will interfere with a basic tapped hole with this length of engagement.

The conditions are not quite the same for errors which throw the image inside of the inner, or lower, boundary of the tolerance area. While the tables of the standard do not forbid it, this method of gaging does forbid the maximum lead error and minimum pitch diameter tolerance occurring simultaneously. This feature makes for better working results, though with greater ease of manufacture, and it will, in fact, often permit a Class II fit to be used, for instance, where the more difficult Class III fit might otherwise have been considered necessary. In view of the present-day ease in getting accurate lead with ground taps and chasers, this greater leniency in pitch diameter tolerances is quite justifiable and desirable in many cases.

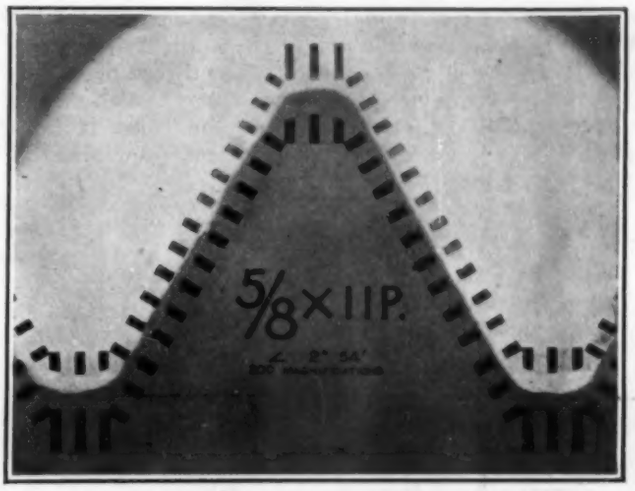


Fig. 12—A small, short-lead screw shown on the chart

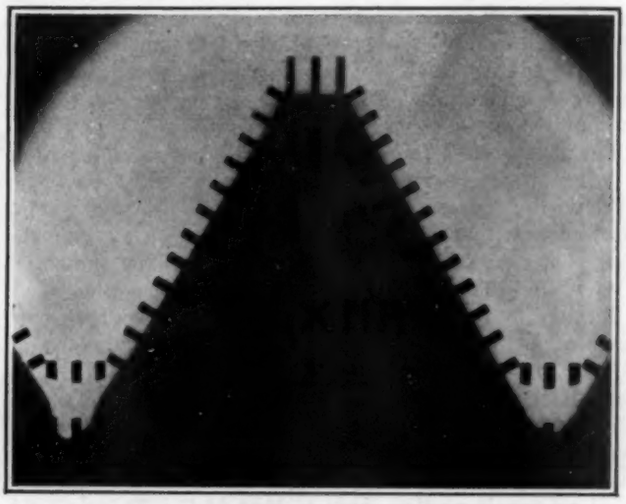


Fig. 11—Image of the basic plug on the chart

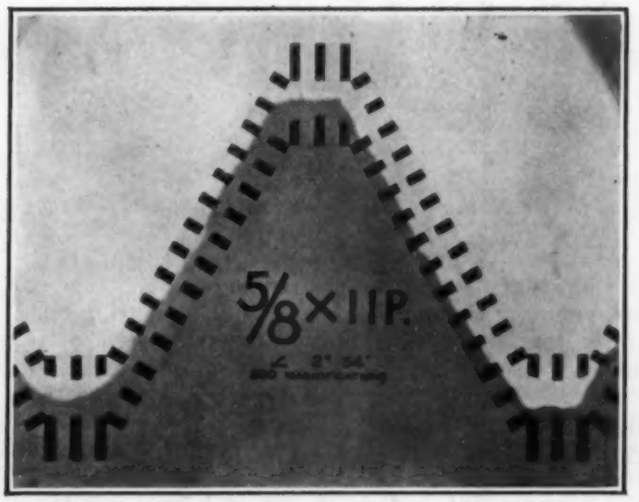


Fig. 13—Unacceptable screw projected on the chart

While the relationships for pitch diameter and lead are absolute, this is not quite true for major and minor diameter. There are extreme cases in which a screw of perfect lead and minimum pitch diameter would show on the chart the maximum outside or major diameter. Such a screw, when calipered, would be slightly

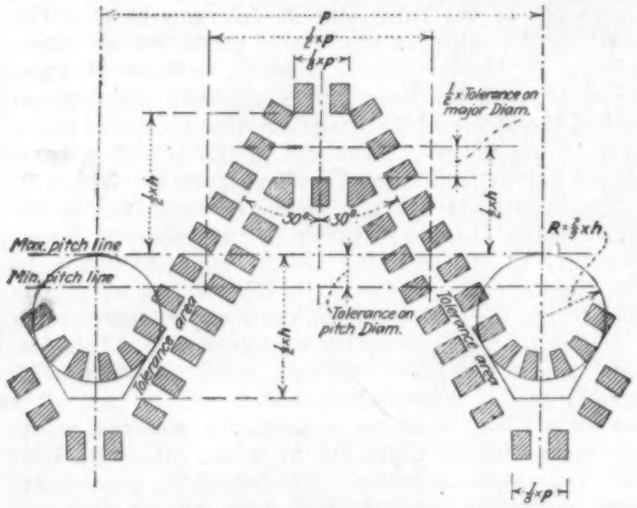


Fig. 14—Method of drawing the comparator chart for screw threads

above the maximum major diameter allowed by the standard. The proper place to check the major diameter is on the stock or blank before threading. This is really a stock dimension rather than a thread dimension, and may be disregarded on the chart if it is within the tolerance area and does not show signs at

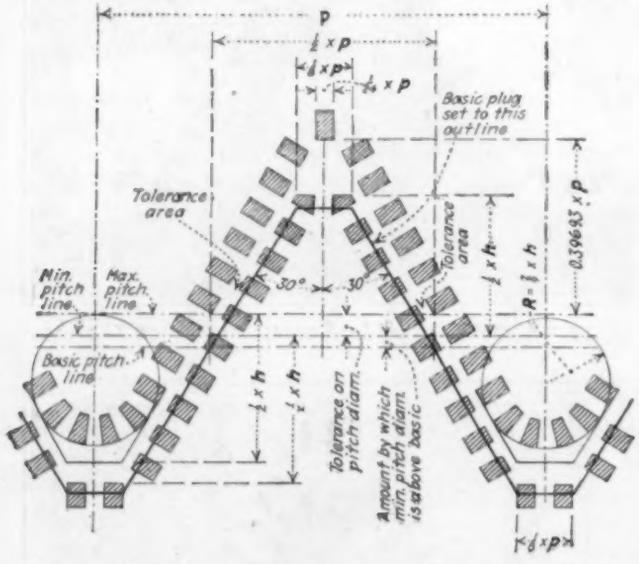


Fig. 15—Method of drawing the comparator chart for tap inspection

the crest of having been forced up to an enlarged dimension by the swaging actions of dull cutting tools.

The conditions are similar for the root form at the minor diameter. If the operator is suspicious, however, that the root is getting beyond the safe outline through the wearing of the chaser tooth points, he may, by the adjusting screws on the microscope holder, bring the image of the screw up to match the upper line of the tolerance area. A dangerous root form will there show itself instantly. The apparatus is then quickly readjusted by inserting the basic plug in the cradles and bringing its image back to match the upper tolerance outline as before.

With all that has been said above, this simple statement remains true: Any screw whose image falls outside the tolerance area should be rejected. Small irregularities which would be quickly smoothed out under the pressure of screwing up in assembly may, of course, be neglected.

The method of drawing a chart for inspecting taps is similar to that for screws, except that, as shown in Fig. 15, the image of the basic plug is set to an outline below the tolerance area. This is because the minimum tolerances for taps are usually set above basic. It has been found satisfactory in ordinary work to control thread sizes on taps and threaded parts by this optical process, without the regular use of other gaging methods.

A Progressive Equipment Buyer—Discussion

By J. R. Ridlon
Terminal Engineering Co., Inc.

Discussion of the above subject by Frederick Franz on page 392, Vol. 61, of the *American Machinist*, together with the editor's request for comments, prompts the following:

The point that different classes of industry would give different answers to the question, "In how short a time must an improvement pay for itself in order to merit its purchase?" is well taken. But, the subject goes much deeper than this. Different departments of any one industry and different operations in any one department will have varying time limits.

It all depends upon how minutely the head of a business examines his costs as to whether he has the available data to apply to the question at issue. Most firms do not have the necessary data. The result is, some one guesses on some point and the formula is only as good as the poorest guess in it. The factories with which the writer has been in intimate contact are very numerous, and there are only two in the list that come anywhere near having the necessary data.

For those who lack this essential information, the question might be put on a different basis—that of dividends. Any business which, as a whole, does not pay dividends, quickly goes out of existence. Every department of any business, therefore, should pay its share of the earnings of the business, and each machine in any department should pay dividends pro rata with the business as a whole.

Let us assume a factory making only one article which requires three operations, A, B, and C. The business as a whole represents an investment of $90,000. The total earnings are $30,000 a year. We can say, therefore, that each of the three departments earns one-third of this, or $10,000 per year.

But we find that department A represents an investment of $45,000, while B and C have only $30,000 and $15,000, respectively, in their equipment outlay. It is immediately apparent that A does not earn as much as B, nor B as much as C, when expressed in percentages. Now assume further that in department A it is found that an expenditure of $15,000 should give that department an earning value equal to that of B. There would be no question about the expenditure being made.

Practical Metallography

By Stanley P. Rockwell
Consulting Metallurgist for A.G.M.A.

Applications of the art of metallography to the solution of problems in the average plant — Practical methods of procedure — Illustrated studies of various examples

PRACTICAL metallography is that part of the art of macroscopic or microscopic study of metals that can be used in everyday work. Its use as such is generally for purposes of raw and finished material inspection, and for finding the source of troubles and their prevention. Its use is practiced by those having at least a fundamental knowledge of the manufacture, treatment and general characteristics of the metals involved. As such it does not involve the care used in preparation or the knowledge required in the higher sciences by the research metallographist.

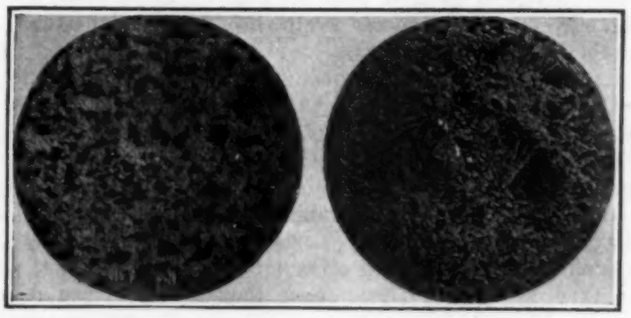


Fig. 1—Left—Gear steel properly annealed. Right—Same steel improperly annealed with forged structure still present

The practical metallographist deals primarily with that which he sees, whether by the unaided eye or with the microscope. The wise metallographist has not only equipment for this part of the work but also surrounds himself with other valuable adjuncts, such as physical testing machines, hardness testers, spark testing apparatus and apparatus for recourse to chemical analysis. He soon forms the habit of laying out his investigation to the end that he does no unnecessary work and each problem encountered aids him in this. He spends no unnecessary time in preparation of samples which for the particular test do not require it.

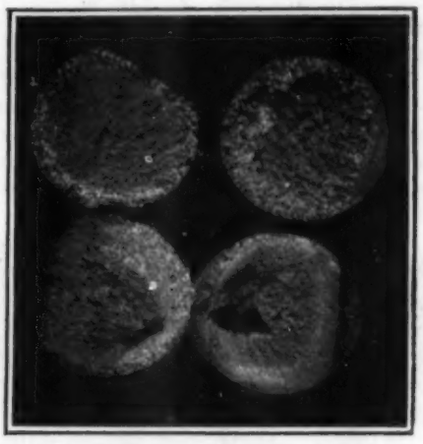


Fig. 2—Fractures of carburized bars. Upper left—Quenched from the pot. Upper right—Cooled in the pot. Lower left—Hardened for case refinement only. Lower right—Entire bar refined

He receives two lots of steel that machine unequally. He first scrutinizes the analysis, if reported; if the solution is not readily found here, he tests for hardness; failing this, micro-examination will undoubtedly tell the reason. He may find segregation of hard material, a carbon content not related to the chemical analysis. He

This paper was presented at the meeting of the American Gear Manufacturers Association, Buffalo, N. Y., April 30, 1924.

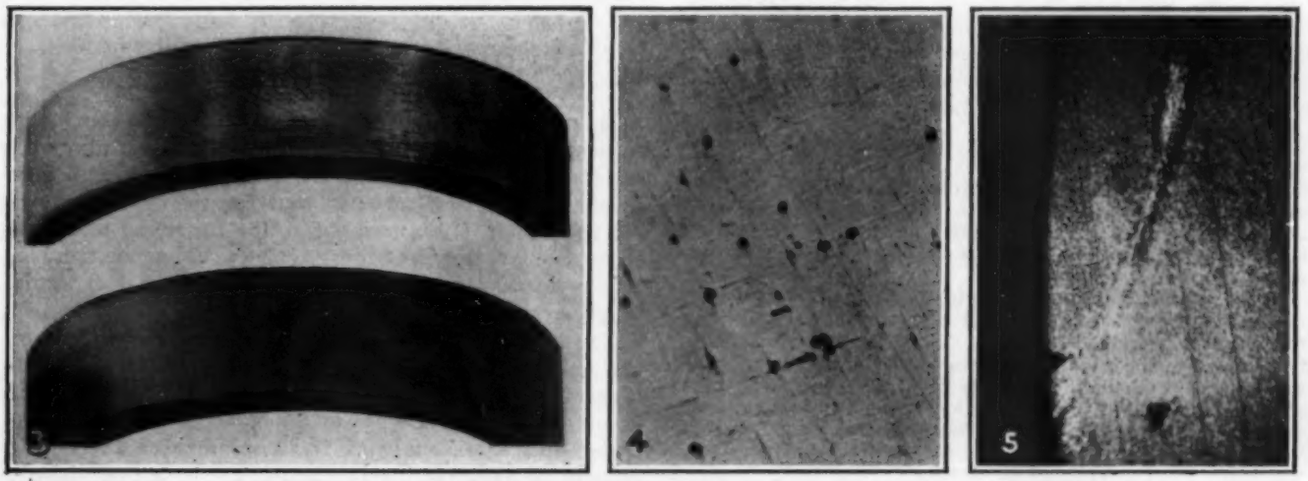


Fig. 3—Grinding cracks in ball bearing rings caused by improper grinding wheel hardness and speed. Fig. 4—Slag appearing in steel not suspected from the chemical analysis. Fig. 5—Trouble-making roak in steel which was accepted on chemical analysis

may find a stringy grain structure (if in forged or rolled steel) when examining a piece through the microscope perpendicular to the direction of the grain. He receives a large gear forging or casting upon which a large outlay of money is to be spent before shipment. He cuts a section, say between future teeth, and examines the surface and interior hardness. This tells him whether or not to anticipate machining trouble. He examines the specimen under the microscope and tells whether it has been properly annealed or normalized, and is safe to proceed with. If not, he can then give it the proper treatment and again examine. In Fig. 1 are shown the effects of proper and improper annealing.

Fig. 6—Apparatus used by the practical metallographist

He finds that most industries simply desire to know whether or not the material used is satisfactory for the work and, if trouble occurs, why, who is to blame, and how it can be prevented in the future. In the purely metallographic end of his work he has three aids at his disposal:

1. The first aid is macro examination, which comprises the observation of a specimen by the eye alone.

This refers primarily to fractures, a number of which are shown in Fig. 2. We all know the merits accruing to different fracture appearances and classify them according to our own knowledge of our individual requirements.

Often the above examination fails to disclose anything of an explanatory nature, in which case we employ deep etching. For this we grind the surface desired on a fine emery wheel and immerse the specimen in acids. The usual acid solution would perhaps contain 20 c.c. of sulphuric acid and 100 c.c. of water.

The use of silver bromide paper to examine for sulphur segregation is also used. The method is to wet the paper in a weak solution of 4 per cent of sulphuric acid and water. Lay this paper on glass with the emulsion side up, on this lay the sample of steel, the surface of which is to be examined, and which has been given a fair degree of polish. This surface should be free of grease stains or finger marks. By standardizing on acid strength and contact time, reliable and comparative results are obtained.

2. The second aid is simply a supplement of macro-examination, which consists in magnifying to a small degree through a suitable microscope, the fractures and etched specimens of the above. Its use is particularly adapted to revealing cracks, seams, etc., as in Fig. 3, and their direction on very highly polished, as well as on less deeply etched, specimens.

3. The third aid carries us into the field of higher magnifications where the structures of materials are so magnified as to stand out clearly. Thus we determine many things not made apparent by the preceding methods. We see impurities in metal, roughly the amounts of the principal elements affecting strength, etc., the heat-treatments used and the quality of these heat-treatments. These investigations are applied in general to highly polished and variable-etched samples of the work.

From experiences in the last eight years, gained almost entirely from inspection of materials and the solving of troubles which have already happened, I am more convinced as time goes on that chemical analysis of steels is of less importance to the average plant than is metallographic inspection.

In steel we usually purchase to some accepted standard. For instance, the A.G.M.A. standards allow a 10-point range in carbon, a 30-point range in manganese, etc. There is a strong trend at the present time by the steel producers to widen these ranges.

An experienced metallographer can with the tools of his trade tell closely the carbon, sulphur and phosphorus contents, and the other elements within reason. Further, and many times more important, he can determine the soundness of the steel and if, with proper fabrication and heat-treatment, it can be made up into a first-class article. Again, he can forecast the best heat-treatment for the purpose intended.

How many times we receive steel shipments that fail in some particular to conform to some definite analysis, and how many times we reject or take a chance on these. Metallography, practically applied, can be used as a further check and incidentally a trouble and money saver.

The steel shown in Figs. 4 and 5, for example was analyzed as follows:

Carbon	0.82
Manganese	0.04
Phosphorus	0.02
Sulphur	0.032

There is nothing in the analysis to show the large percentage of slag present. The bar of steel analyzed satisfactorily, but was full of seams and roaks. A few specimens examined showed that for the type of forging for which it was purchased, the upsetting and consequent enlargement of these roaks would cause trouble. It was also determined that this particular stock could be used on other parts with safety.

The above examples are given only to show some of the many valuable findings possible for the metallographist. I have made reference to the tools of the metallographist. These are several, and are illustrated in Fig. 6, but with this equipment a surprising amount of valuable investigation may be accomplished:

A vise and hacksaw for cutting samples. A low-power binocular microscope with 5 and 10 eyepieces and 55- and

24-mm. objectives. This will be capable of magnifying objects up to 20 diameters.

A metallurgical microscope with 5 and 10 eyepieces and 4-, 16- and 32-mm. objectives. This will be capable of magnifying up to 200 diameters.

A high-speed (3,500 r.p.m.) hard emery wheel, to be used for spark testing, rough polishing, and cutting hard samples.

Several different cuts of flat files for rough polishing.

A set of a series of polishing papers and cloths for the different polishing operations.

A piece of plate glass to lay these papers on to assure a flat surface.

A piece of broadcloth stretched on a piece of glass for obtaining a mirror polish.

A wash bottle containing a solution of tripoli or jeweler's rouge, to be squirted on the broadcloth.

A package of silver bromide paper and fixing salts.

Cotton and tooth picks for etching.

Concentrated acids; sulphuric, nitric, and hydrochloric.

Picric acid crystals.

Medicated alcohol.

Several small glass dishes for etching.

Several 4-oz. reagent bottles for mixed etching reagents.

Two porcelain basins for macro-etching.

Hot and cold water.

A package of darning needles for scratch tests.

A hardness tester for exploring samples.

A small gas or electric furnace with pyrometer, for annealing and heat-treating.

Now as regards a man to use this equipment. A trained man, of course, is desirable. Small industries, however, can not afford such a man, and it is necessary to recruit him from the plant. The requisites are that he be open-minded, with at least a high-school education, inventive, mechanical and studious. Nearly every plant has such a man. If the work is not enough to engage all his time, he can use the remainder on inspection. In fact this whole line of work should be in the inspection system. The training of such a man, if he is of the right caliber, can be safely left to himself, aided by an occasional visit from a trained metallographist. Good books should be provided.

He should concern himself only with facts and the things he sees. He should not theorize on subjects for which he is not qualified by study. He should convince himself of each step and not jump at conclusions until he can verify them. He should seek the advice of others more advanced in this work. He should be able to prepare his specimens quickly, spending no more time on them than is required to find out what he is after. He should become adept in handling various pieces of apparatus and strive to solve his particular problem in a logical manner.

It may be that this sounds like a big bill. It must not be expected that perfect results can be obtained in a moment. A man, however, who takes his work seriously and meets the above requirements can progress in this line of work the same as in any other.

You may say, "We don't have any need in our plant for this work." In this you are wrong. You may have someone outside your organization who attends to such work for you and, if the work is properly conducted, this is the same thing. I have a number of concerns who send me all their problems. Many of them are not connected directly with heat-treatment. Many of them are at first hand blamed to heat-treatment, and later are found to be due to other causes. These concerns when I first approached them, took the same attitude, but after several tryouts they realized the advantage of securing the facts quickly and economically, rather than in taking a chance that the trouble would straighten itself out and later recur. More and more problems are coming to my attention each month, and from distant places. Many of these problems have bothered these people because of lack of previous experience or the equipment necessary to investigate. The majority can be solved without a plant visit.

I regret that the following studies are not all related to the gear industry. From the metallographist's standpoint, however, they are correlated—machining, heat-treating, warping, cracking, hardness, etc.—and are interesting to all industries from those making textile parts to gears.

Study No. 1

A manufacturer purchased an open-hearth steel:

Carbon	0.14
Manganese	0.87
Phosphorus	0.069
Sulphur	0.079
Silicon	0.09

and a Bessemer steel:

Carbon	0.13
Manganese	0.88
Phosphorus	0.054
Sulphur	0.057
Silicon	0.10

He judged from the analyses that these steels were the same and put them in the shop. At once trouble developed with the open-hearth steel. It welded poorly

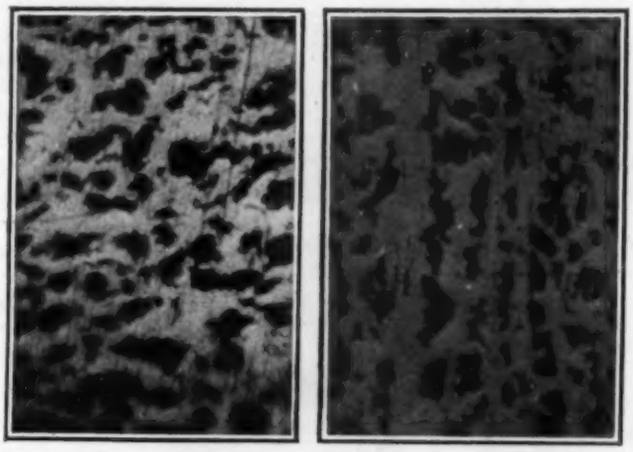


Fig. 7—Two steels with same analysis and hardness. Right—Open-hearth product welded and machined poorly. Left—Satisfactory Bessemer steel

and machined poorly in comparison with the Bessemer steel. As the open-hearth on account of its higher phosphorus and sulphur contents should have given slightly better machining (the hardness values were equal), the phenomenon was puzzling until the specimens were polished and etched with picric acid as shown in Fig. 7. The lamination causes poor machining. An inspection of raw material by the microscope is now used.

Study No. 2

A certain tool of taper section when hardened cracked in nearly the same place each time. The carbon was about 0.75 per cent. The phosphorous and sulphur were low. Appearance of the fracture showed nothing. The specimens were forged. The cracks appeared with such precision that no stretch of the imagination could assume a seam or a similar flaw as the cause. The specimen was roughly polished, lightly etched with nitric

acid and a needle drawn with constant pressure over the piece at right angles to the crack. As shown in Fig. 8, this disclosed that all the metal on one side of the crack was untouched by the needle, showing hard; the other side was scratched by the needle, showing soft. Further, the etching disclosed the soft side all dark, with some dark blotches in a white background on the hard side. We know that the dark is troostite and the white, martensite. Evidently the cracking was just on the line between soft and hard metal. We know that martensite is formed by quenching above the critical temperature, and troostite by heating below the critical temperature. It stood to reason that if this abrupt line of hardness demarkation could be eliminated, the trouble would be over. It developed that the hardening in lead and the quenching in water was done on fixtures, the work remaining still and immersed in each fluid a definite depth. An up-and-down motion given to the tool in each of the fluids eliminated this troublesome feature.

Fig. 8 — A cracked axe blade. Needle scratch perpendicular to crack

Fig. 9 — Needle scratch test on hardened knob. Hardening heat too low to harden carburized portion

Study No. 3

A steering-rod ball was specified to be carburized and cyanide-hardened and to show, besides a certain hardness by Rockwell test or Shore scleroscope, a fibrous core when the stem was fractured.

This knob was about 1¼ in. in diameter. The heat-treatment given was, after carburizing, 1½+ in., to cool in pot and cyanide at 1,425 deg. F., quenching in water. The fibrous core was secured and the knob was file-hard, though it showed soft to the Rockwell and Shore instruments. A section was polished, lightly etched and needle scratched, Fig. 9. This operation showed that the case formed by carburizing had not been hardened and that the file hardness came only from the cyanide case.

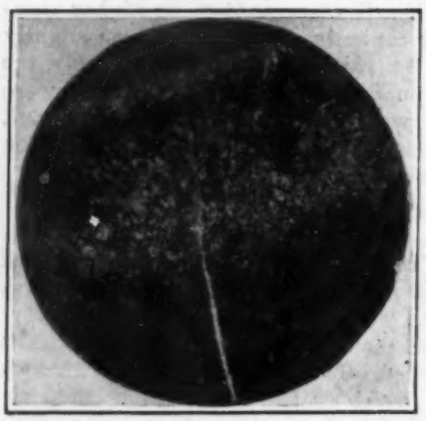


Fig. 10—Steel of Fig. 9 properly hardened

By raising the heat of hardening, the carburized case was hardened but the core was crystalline. In order to meet all the conditions it was found necessary to first heat the piece to above the critical temperature of the core and quench before cyaniding.

Study No. 4

A crack developed in carburizing steel. The hardener was held to blame. Fair polishing alone disclosed, as seen in Fig. 11, that the crack was caused by internal defects in the steel itself.

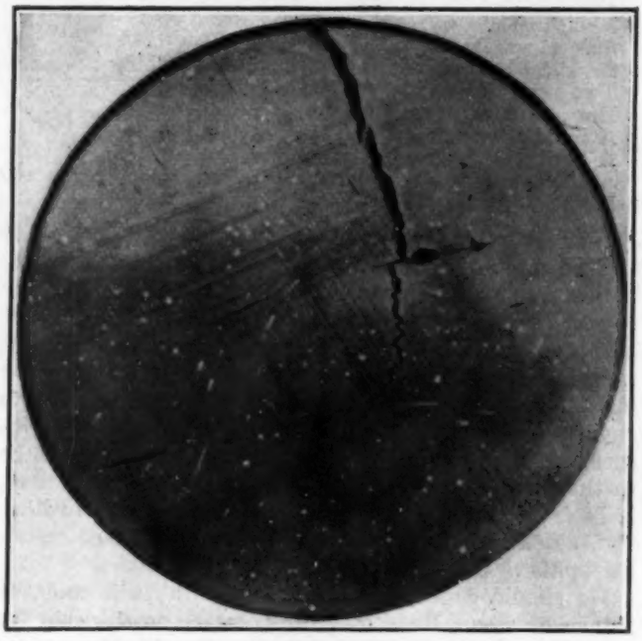


Fig. 11—Crack in carburized ball thrust disk developed internally and due to manganese sulphide

Study No. 5

Bronze pinion wire as received gave variable properties of durability to wear. Analyses of the good-wearing and poor-wearing material were the same, but polishing and etching in ammonia and peroxide showed

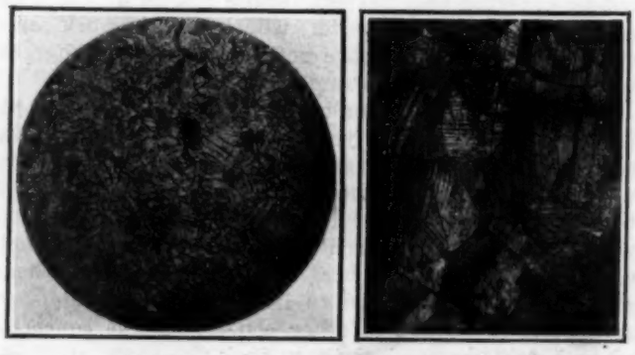


Fig. 12—Different grain structures in one shipment of bronze. Left—Satisfactory. Right—Broke in dies

considerable differences in grain size, as indicated in Fig. 12. This was carefully watched and checked in succeeding shipments and it developed that, analysis and hardness being equal, the smaller grain size was desirable.

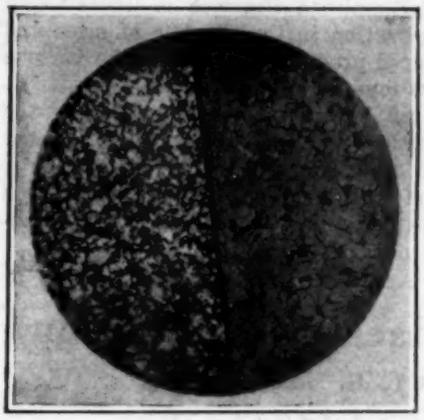


Fig. 13 — Left — Case-hardened bushing carburized deeply and properly. Right—Competing bushing cyanide-hardened only

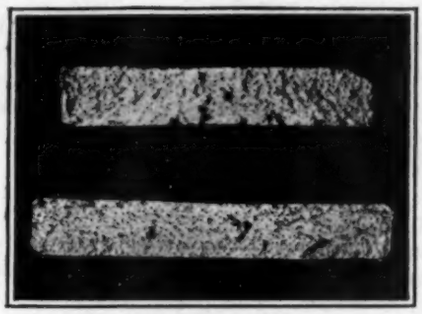


Fig. 14 — Fractures of hardened bushings. Long specimen carburized, short specimen cyanided

Study No. 6

A concern making a good quality of carburized bushing, and supplying it to a trade which knew nothing of the merits of heat-treatment or of steel, was bothered with inferior competition. The competition marketed a cyanided bushing at a lower price. It was desired to secure some visible evidence of the quality of each, by which the prospective customers could quickly see the advantages of the proper material and treatment.

Fractures of each type were secured, polished and etched with nitric acid, and photographed at the same diameter with the result shown in Fig. 13. When augmented by fractures, Fig. 14, the prospective customer could easily see the merits and demerits of this particular part for the class of work and could form a sound judgment of values.

Study No. 7

Forged springs, though equal as regards commercial heat-treatment, gave widely varying results under compression tests. Nothing could be gained by hardness tests. The microscope showed, Fig. 15, varying degrees of decarburization, which was traced back to forging, uneven grinding of opposite surfaces, to high forging heats and to original hot-rolled metals.

Fig. 15—Decarburized spring for sporting rifle

Metallography in this case showed what was wrong and what would have to be eliminated to secure uniform results.

Study No. 8

A maker of high-speed taps purchased a small furnace because it would heat very quickly and would save his fuel costs. His work when hardened tested hard. After grinding it was soft. The metal near the surface was

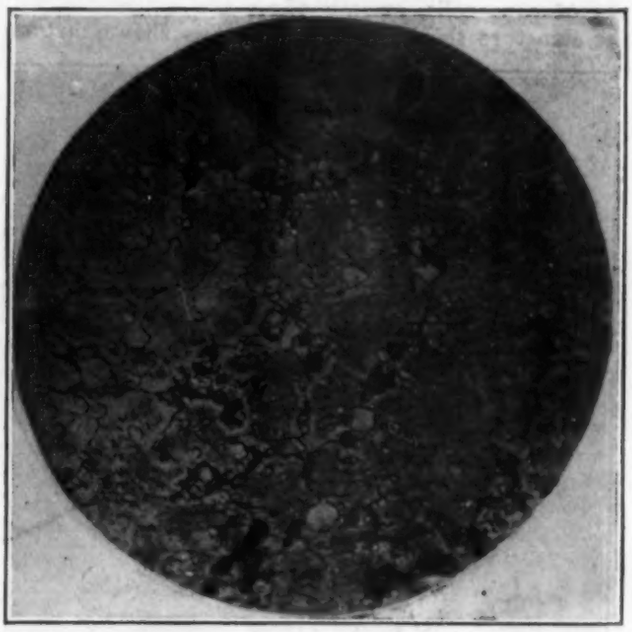


Fig. 16—High-speed steel tap heated too quickly and burned

burned. It developed that the furnace was too small for the taps. There was lack of balance-wheel effect. A few taps admitted to the furnace cooled it off. By the time the main portion of the metal appeared hot enough the furnace had recovered its momentum and burned the teeth.

The structure seen between the burned areas in Fig.

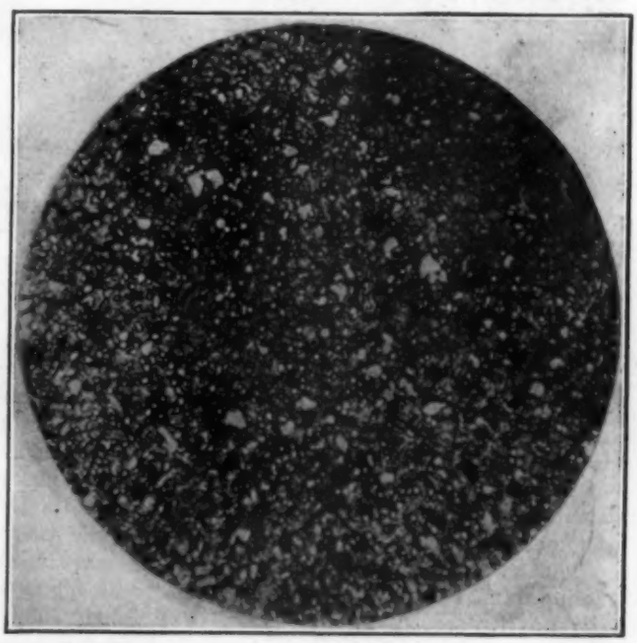


Fig. 17—High-speed steel properly hardened and drawn back for secondary hardness

16 is typical of hardened, not drawn, high-speed steel.

When properly drawn for secondary hardness, a good example is illustrated in Fig. 17. Many concerns use the microscope as a check on proper hardening and proper drawing.

Study No. 9

In the rolling of strip steel from wire without the use of edge rolls, smooth edges are impossible with the structure shown in Fig. 18. This shows that the

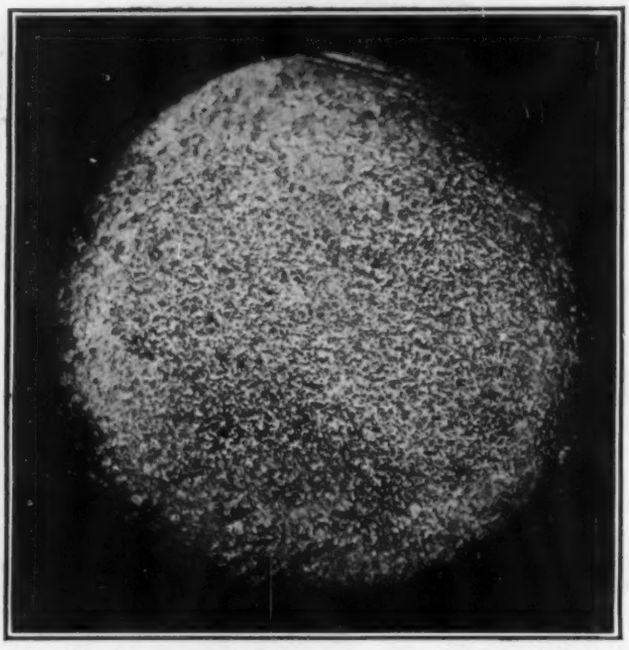


Fig. 18—Large grain structure on surface of carbon steel wire

wire has evidently had an excessive quick high heat in the annealing. It is interesting to note that in rolling wire, the metal which is later the edge receives no change for mechanical breaking up of the grain. It is not crushed but is simply pushed away.

Standardization Work of the Government

Not only are national technical societies, trade associations, and commercial organizations, such as the Chamber of Commerce of the United States, carrying on or promoting standardization activities for their members, but the United States Government, representing all interests, in doing an important work, says the booklet, *Standardization*, published by the American Engineering Standards Committee.

The government is interested in standardization as a purchaser: the Federal Specifications Board, made up of representatives from all departments, was organized to unify the specifications of the various departments and independent establishments of the government and to bring them into harmony with the best commercial practice wherever conditions would permit.

The government through its departments is also doing standardization work as a part, and an important part, of its service to the public. The Department of Commerce particularly has several divisions whose entire activities lie in this general field.

The Bureau of Standards is a highly developed and efficient organization devoted primarily to research and the standardization of fundamentals.

The Division of Simplified Practice is undertaking to bring about a reduction in the number of sizes and styles of manufactured products by getting the various industries and users together in conference.

The Dictionary of Specifications, prepared by the Bureau of Standards with the co-operation of the Bureau of Foreign and Domestic Commerce, will contain information regarding purchase specifications in a form that will be available to federal, state and municipal purchasing departments.

Famous Machinists of History

By H. H. Manchester

John Fitch (1743-1797)

John Fitch was born in what was then East Windsor, Conn. He received only a common school education, and as a boy was apprenticed to a clock maker. He was ill treated at home, and jumped from the frying pan into the fire by making an unlucky marriage. From about 1769 he wandered from place to place as a mechanic, becoming a clock and watch maker at Trenton, N. J.

When the Revolution broke out, he made use of his knowledge as a machinist to start in as a gunsmith for the revolutionary forces, but when Trenton was captured by the British, his shop was destroyed.

He was with the troops at Valley Forge, later becom- a gunsmith in Bucks County, Pa.

In 1780 he was employed in making surveys in Kentucky, and two years later went West with £150 worth of goods as a trader. The party was attacked by Indians, and either killed or captured. Fitch, however, saved his life by conciliating the Indian leader, and eventually escaped to Warminster, Pa.

In 1783, realizing the need for transportation up the rivers, Fitch began experimenting on steamboats. That year he built a model with wheels on both sides, and the next year a boat which was run by paddles.

In order to get money for this purpose, he made a map of the northwestern territory, printed it on a cider press, and cleared $800 on the sale.

Formation of Company

With this start he formed a company and received rights to navigate the rivers of New York, Delaware, Pennsylvania, and Virginia.

In 1787 he built a steamboat 45 ft. long, which was driven by paddles on each side, and later constructed two other boats, one of which ran all summer between Philadelphia and Burlington, N. J.

A United States patent was given him in 1791, but when he visited France in 1793 the revolution was already under way and he could do nothing there. Incidentally his papers were seen at that time by Fulton, and helped to arouse Fulton's interest in the problem.

In 1794 he returned to America, two years later running a small steamboat driven with a screw on Collect Pond, New York City.

The steamboat which he built to run on the Ohio was destroyed by storm, and other misfortunes followed, so that Fitch finally lost heart and committed suicide at Beardstown, Ky., in 1797.

New York Central Cylinders

By L. C. Morrow
Managing Editor, *American Machinist*

A comparison of his own methods and operation sequence with those of other shops will suggest economies and improvements to the master mechanic

LOCOMOTIVE cylinder castings are similar on all roads, but methods of machining them, and sequence of operations differ. Just how the work is done depends upon the equipment in the shop quite as much as upon the men who are responsible for routing and methods. It is suggested that each master mechanic who reads these pages compare the methods of the West Albany shops of the New York Central with the methods in his own shop, profiting where he can. Operations that may be termed "obvious," that is, where the mere naming of the work done and the machine used tell the reader how it is done, are not illustrated.

On the 72-in. planer shown in Fig. 1 the surfaces marked *A*, and the exhaust base, are planed as the first operation. The second operation is to bore and face the cylinders and valve chambers, illustrated in Fig. 2. In the boring operation the cylinder is located by two of the surfaces planed in the first operation, after which the layout for drilling is made. The work is so arranged that one man performs the three operations.

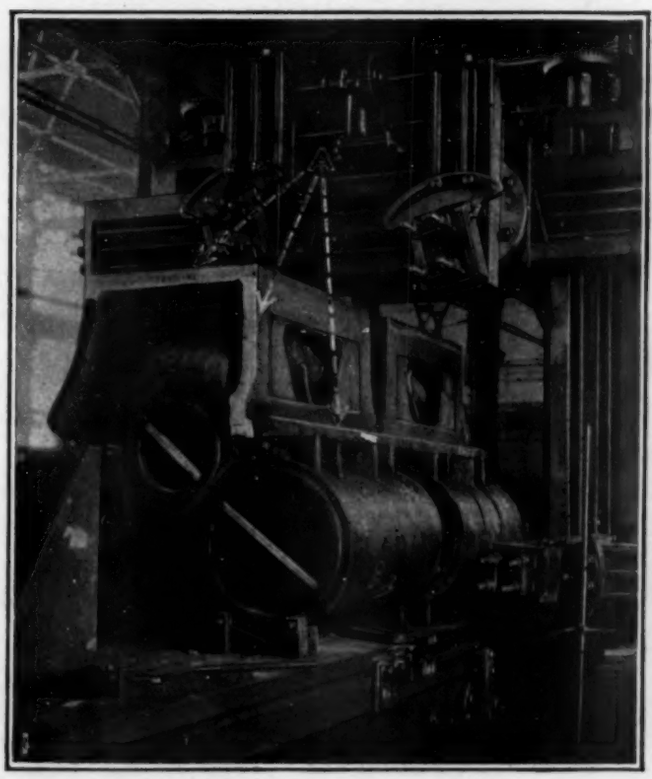
Drilling and tapping are done on a 6-ft. radial, Fig. 3, as the fourth operation, except the splice-bolt and saddle-bolt holes. The fourth operation includes drilling and tapping the holes for steam pipe joints.

Cylinder and valve-chamber bushings are then applied (fifth operation), the cylinders being heated to expand them for easy entrance of the bushings.

Operation six is the refacing of the ends of cylinder and valve chamber.

The splice-bolt holes are drilled in operation seven. The holes are drilled in one cylinder, after which the two cylinders are matched, and then the second cylinder is drilled. The machine is the one shown in Fig. 3. Saddle-bolt holes are drilled with the cylinders in position on the frame.

Cylinder bushings are bored on the machine shown in Fig. 2 and are turned on a lathe. In the turning operation the bushings are supported on plugs slightly less in diameter than the outside diameter of the bushing, turned for half their length to a diameter a few thousandths less than the bore, so that they will enter and support the bushing. The plugs have center holes



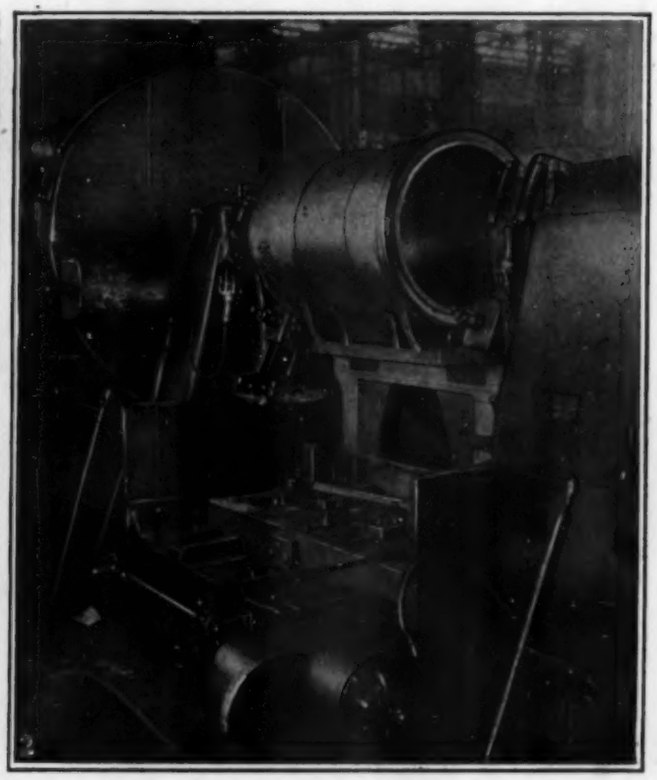


Fig. 1—Planing—the first operation. Fig. 2—Boring and facing cylinders and valve chambers

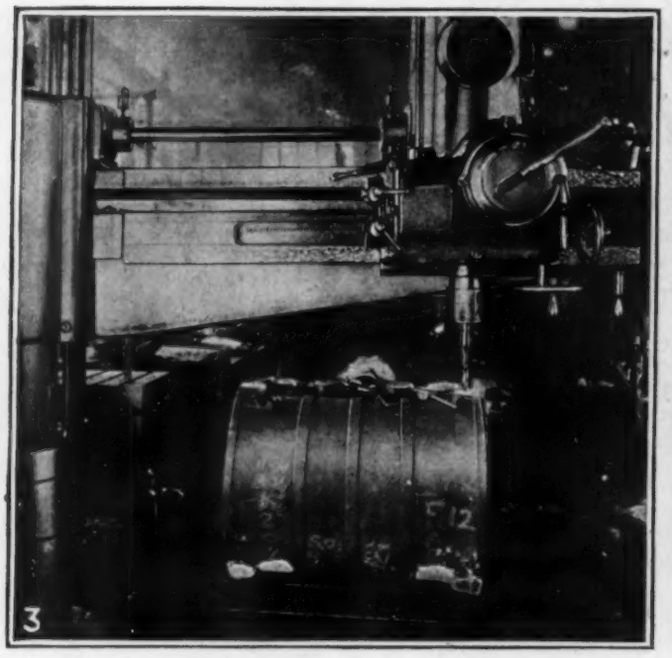


Fig. 3—Drilling and tapping—fourth operation.

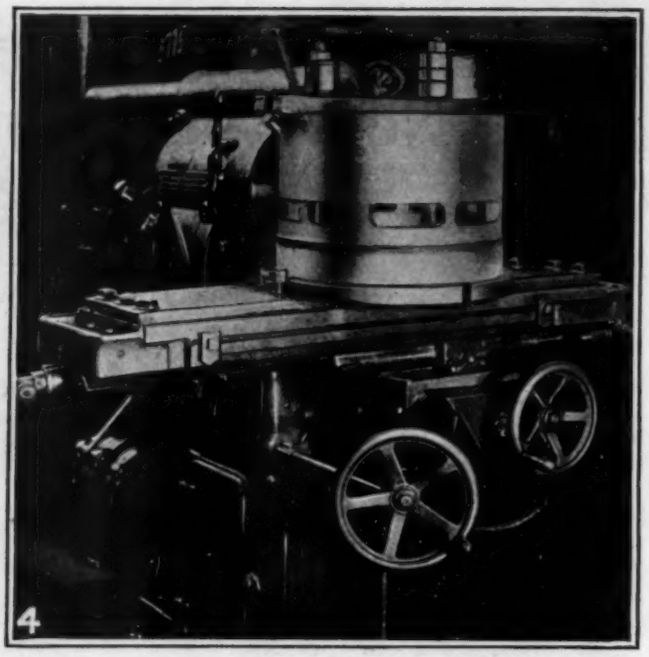


Fig. 4—Milling valve ports in valve-chamber bushings

and are supported between the centers of the lathe.

Valve chamber bushings are rough-turned and finish-bored in one operation on a vertical turret lathe. The ports are milled as shown in Fig. 4 on a knee-type plain miller using a 1-in. end mill. They are finish-turned on a lathe to fit the valve chamber.

Machining, Welding, Brazing and Soldering Monel Metal

Circular No. 100 of the Bureau of Standards, says that in machining properties, monel metal resembles copper, nonleaded brass, and alloy steels in that a tough chip is produced, necessitating some changes from machining practice with steel and cast iron in order to obtain the best results.

Cutting tools for monel metal should be made from high-grade, high-speed steel and ground with sharper cutting angles than are used ordinarily on steel. A lathe tool with a 13 deg. clearance, 20 deg. top rake, 9 deg. side slope, or one with a 6 deg. clearance, 8 deg. top rake, and 14 deg. side slope will work well with a ¼-in. cut and ⅛-in. feed at a speed of 50 to 60 linear ft. per min. It is advisable to provide proper lubrication in all monel-metal machining operations, although the metal may be readily machined dry on the lathe.

The same general considerations apply to drilling, milling, tapping, and reaming. The metal is worked quite extensively in automatic machines in the production of screws, bolts, and similar products.

Data for Welding

Monel metal may be welded by the oxyacetylene, the metallic or carbon-arc welding, or by the resistance methods, although certain precautions are advisable in order to produce sound and ductile welds by the two former methods.

In using the oxyacetylene process, the flame should be slightly reducing and the torch tip one or two sizes larger than for steel of the same size. No flux is usually necessary, but the work should be well cleaned from scale and oxide, and care should be taken to use bright, clean welding rod and to avoid oxidizing the weld. The weld should be built up well above the surface and completed in one spot before starting in another; it should not be built up in horizontal layers.

Welded nickel and monel metal tubes are being manufactured from sheet by the oxyacetylene process.

The metallic arc-welding of monel metal follows steel practice, with two important modifications. To secure the best results—that is, a sound and ductile weld—it is desirable to coat the monel-metal welding rod with a powdered deoxidizer; for example, an alloy of the following composition:

	Per cent
Magnesium	14-16
Manganese	27-33
Silicon	45-50

and to reverse the polarity; that is, make the welding rod positive

Welds made in ½-in. monel plate by either the oxyacetylene or metallic-arc method will average 45,000 lb. per sq.-in. tensile strength and 90 per cent elongation in 2 inches over the weld. They can be bent 90 deg. before cracking.

The Wilson Welder and Metals Co., Inc., has recently put on the market a monel-metal welding rod, which it recommends for arc-welding gray cast-iron parts. It states that the coefficient of expansion of this welding metal or filler closely approximates that of gray cast-iron, thus reducing the cracking which usually accompanies the welding of cast iron. It claims that it and a large number of users have been uniformly successful in producing a homogeneous and readily-machinable weld in gray cast-iron.

The resistance welding of monel metal by the spot or butt method is entirely similar to that of steel. The metal may be welded to copper or steel by this process.

The soldering and brazing of monel metal is carried out in the same manner as for copper. It is best, in soldering, to tin the surfaces before making the joint.

Manufacturing the Right Line Radial Drill

By John Haydock

Planing operations are distinguished by ingenious use of fixtures for large pieces—Milling, drilling and planing of bases, columns, arms and heads on heavy machines

THE development of any new machine involves the solution of two problems; first, that of design and then that of manufacture. In the case of the Right Line radial drill, Fig. 1, these questions were of particular interest because this machine represented a departure from the standard methods of drilling machine design and because of the immediate popularity with which it was received. It was necessary not only to deal with a number of unusual machining conditions but also to meet a sudden demand for production at a reasonable cost. In this article are shown some of the questions that arose in manufacturing this machine and their solution.

One of the distinctive features of the Right Line radial is the divided column which permits of a direct drive from the motor to the spindle through a minimum number of gears and bearings. The column is provided with four V-ways for mounting the arm and two cylindrical surfaces at one end for supporting it vertically by means of ball and roller bearings. There is also a bored hole at each end of the casting, one at the lower end concentric with the cylindrical bearings and one at the upper end slightly offset for supporting the elevating screw.

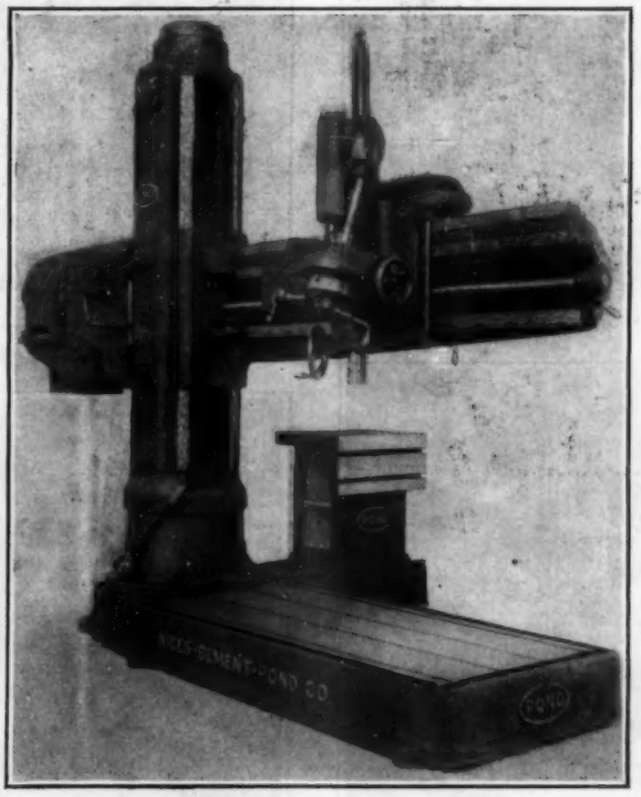


Fig. 1—Plain 6-ft. Right Line radial

The columns are first centered in a Niles' horizontal drilling machine and then mounted on centers in a Pond 48-in. heavy lathe, Fig. 2. The surfaces supported by the roller bearings are turned and polished after which the castings are bored in the same machine by holding one of these surfaces in a steadyrest. The castings are then set up in a special fixture on a Pond 36-in. planer. This fixture supports them in the center at one end and on the larger turned surface at the other, the alignment being obtained by tongues fitting the slots in the planer table, Fig. 3. A template is permanently secured to one end of the fixture to insure a correct and uniform setting of the tools for the ways. One side is planed, the casting indexed through 180 deg. in the fixture and the planing completed on the opposite side. The castings are again put in the horizontal drilling machine to bore the hole for supporting the elevating screw which makes them ready for scraping.

The arm for the plain drill includes not only the horizontal member which supports the head but also the portion which slides vertically on the column. These are cast in one piece to give maximum rigidity and by a careful study of the machining operations are manufactured in a shorter time than with a two-part construction. The cross-section of the arm is designed to give the greatest resistance to deflection and torsional stresses and to permit the easy traverse of the head. The lower bearing surface is set back, making the center distance between the spindle and the driving shaft as small as possible. The upper V-way is close to the spindle and this takes the vertical thrust when drilling. The top surface is set at an angle which supports the weight of the head through large hardened steel rollers; this angle is perpendicular to the line of force exerted by the weight of the head so that the rollers operate with the maximum efficiency that can be obtained. This is a feature to which a great deal of importance is attributed.

The arms are first planed singly on a Pond 42-in. planer, the tracks which support the head being machined. Then five are set up on a 120x120-in. planer on special fixtures which locate them from the surfaces finished by the first operation. The surfaces that fit the ways on one side of the column are planed, the fixtures insuring their squareness with the first planing.

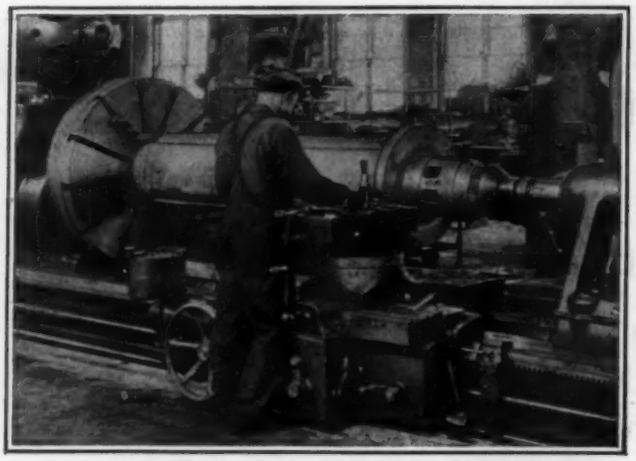


Fig. 2—Turning columns in a 48-in. lathe

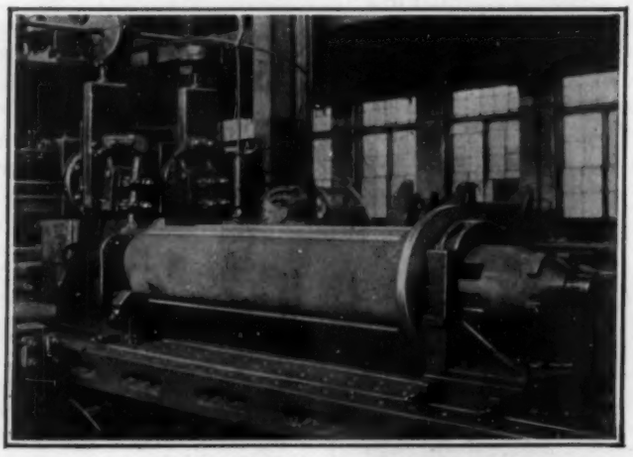


Fig. 3—Planing columns

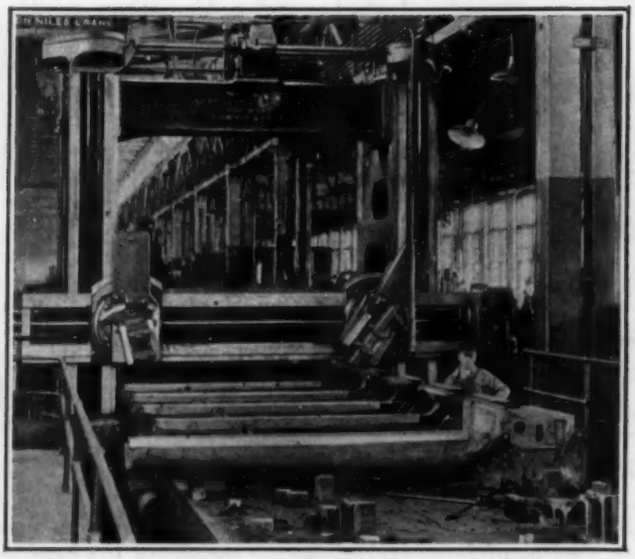


Fig. 4—Planing arms in 120-in. planer

The arms are then turned over on another set of fixtures which locate from the surfaces just completed and the corresponding operation performed on the other side. Fig. 4 shows this last operation with the jigs for the second planing still on the machine. It will be noted that all the fixtures used for the columns and arms are capable of adjustment for different lengths so that they may be used for making a number of different sizes of drilling machines.

The next operation is done in a horizontal drilling machine with the use of a special jig. The castings are supported vertically so that the holes may be bored from the various sides by rotating the table without disturbing the set up, Fig. 5. The head traverse rack is then drilled to the arm on a Right Line radial drill, completing the machining operations.

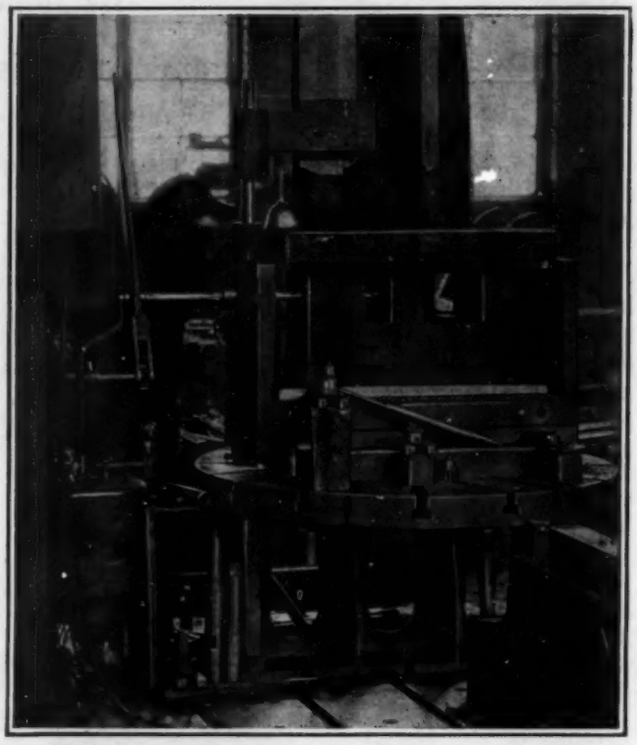


Fig. 5—Boring arms in a horizontal drill

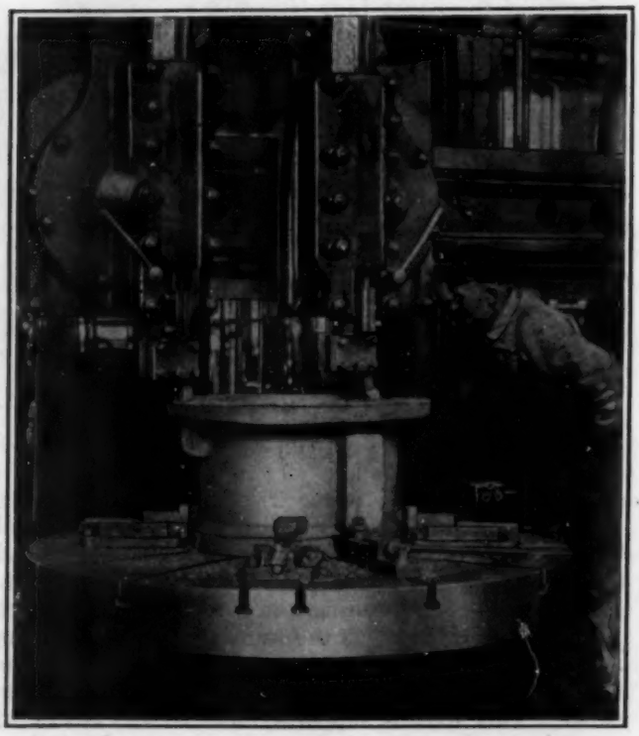


Fig. 6—Turning the pedestal in a Niles 72-in. boring mill

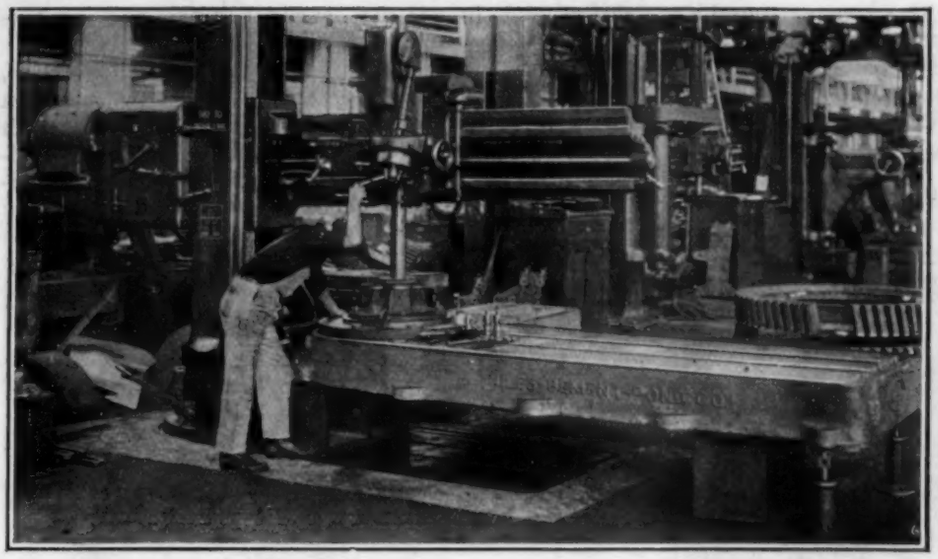


Fig. 7—Boring bases in a Right Line drill

The arms for the universal radials are of necessity separate from the slide which is supported by the column. These castings are planed for the tracks as are the plain arms but are then swung between centers in a Pond 48-in. heavy lathe by means of a fixture which clamps them on the finished surfaces. In this set up, the circular bearing which forms the swiveling contact with the slide is turned. The slides are turned in a Niles 72-in. vertical boring mill before planing.

The swinging of the arm is effected by rotating the entire column. To do this the column is mounted in a cylindrical member called the pedestal which is securely bolted to the base. The first machining operation on the pedestals consists of turning them on the top and bottom and boring them for the seat of the upper roller bearing which supports the column. This is all done in a Niles 72-in. vertical boring mill Fig. 6. A flat spot is then planed on the side for mounting the electric clamp bracket and the hole for the clamping screw is bored. These operations are performed on a Pond 36-in. planer and a 60-in. duplex boring mill respectively. The pedestals are then completed by jig drilling the bolt holes for securing them to the bases in a Right Line radial.

The bases are planed on a 120-in. planer, about five being set up at one time. As this requires a wide straight cut multiple cutting tools are used to advantage in roughing. The lower roller bearing previously mentioned in connection with the column is located in a recess in the base. By the use of a special fixture the holes for seating these bearings are bored on a 6-ft. Right Line radial, Fig. 7, using a boring bar and cutter in the spindle. At the same set up the bolt holes for securing the pedestals are drilled with the jig used for the corresponding holes in the pedestal.

The head involves the longest operation of any of the parts of the machine but by a careful analysis of the operations they have been reduced to a minimum cost considering the accuracy required. The castings are planed in lots of ten on special fixtures mounted on the table of a 36-in. planer. The tools are set from a template on the first fixture, Fig. 8, for machining the surfaces that slide on the ways of the arm and the seat for the steel cap that supports the driving bevel gears. Next the heads are set up on a 54-in. planer and machined for the seat of the main spindle cap and the feed worm wheel cover. They are then milled in pairs on a Bement milling machine for the surfaces receiving the feed box and counterweight cover.

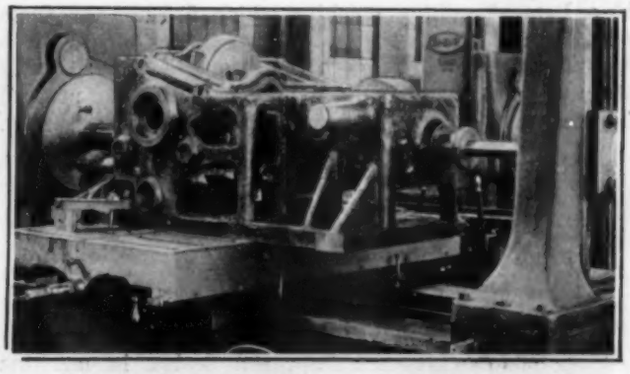


Fig. 9—Boring heads in a 72-in. Duplex mill

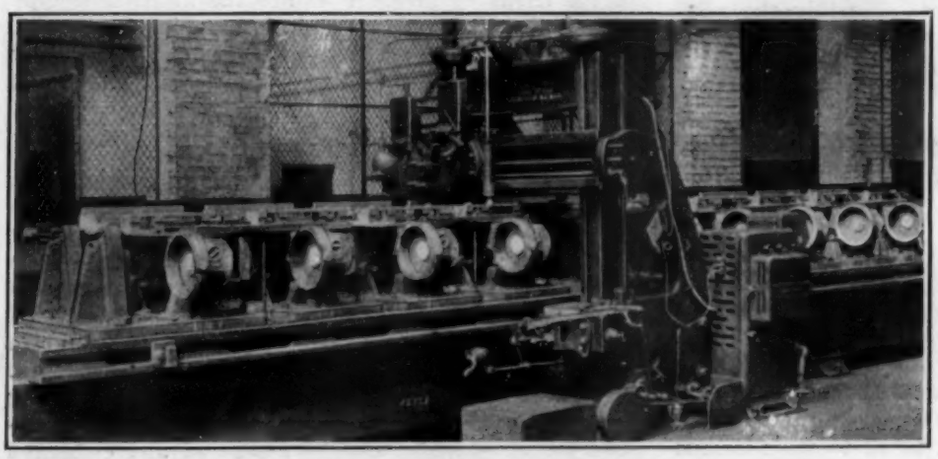


Fig. 8—Planing drill heads

The caps are drilled in place on the head in a Right Line radial, a special jig being used to locate a hole in the back of the head for supporting a stud on the steel cap. The heads are then bored in a jig using a 72-in. duplex boring, milling and drilling machine, Fig. 9. This jig locates the head from the V-way which slides on the arm and includes all the bearings in the head. This arrangement seems worthy of special note.

Two gear boxes are used, a two-speed box with a simple back gear for use with a variable-speed d.c. motor and

an eighteen-speed box for use with a constant-speed a.c. motor. Either box may be mounted at the back of the arm, the driving motor being supported on a bracket bolted to the box. This arrangement gives a well-balanced machine as the weight of the gear box and motor on one side of the column offsets that of the arm and head on the other.

The machining operations are similar on both styles of boxes. Fig. 10 shows ten of the constant speed

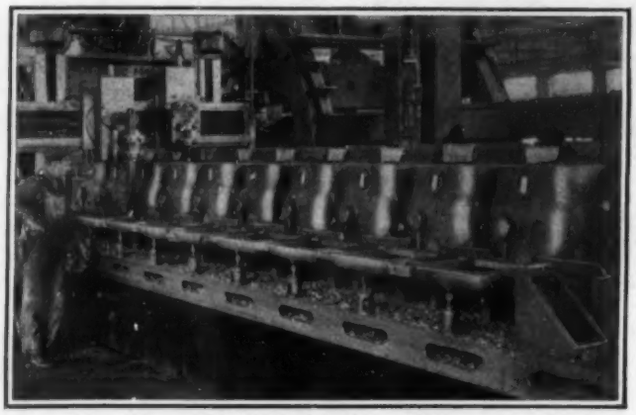


Fig. 10—Planing a.c. speed change boxes

type set up in a 36-in. planer for the first operation, three tools being used. The castings are then milled in a Bement milling machine which finishes the spots for the shifting levers. They are then bored in a special jig on a duplex borer and the holes for securing them to the arms drilled. Bronze bushings are pressed in the bearings and the boxes are ready for assembly.

(To be concluded)

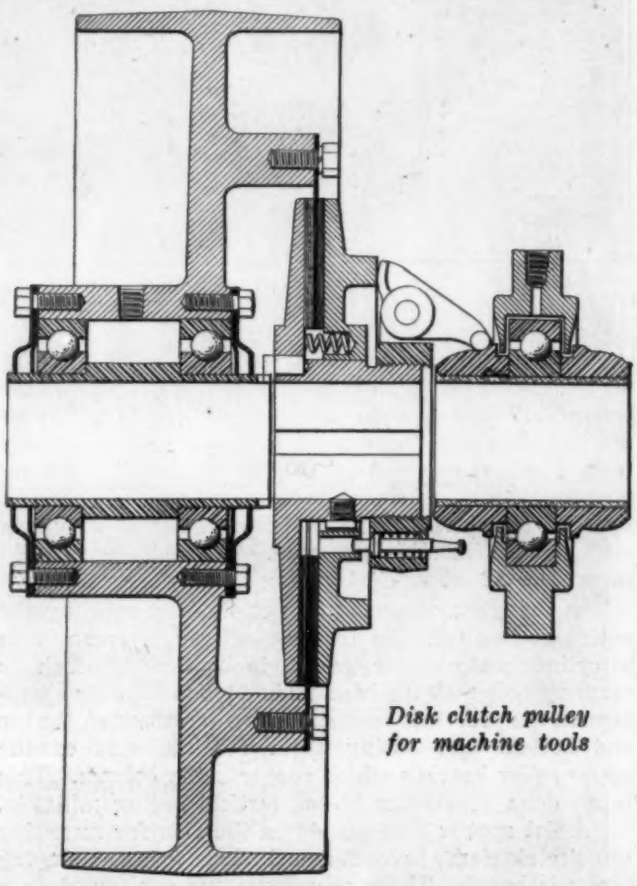
Developments in Clutches for Machine Tools

By P. H. Batten
Twin Disc Clutch Co.

The tendency toward improved design in machine tools must necessarily lead designers to consider the vital question of adequate control of power transmission in its most simple and reliable form. Tight- and loose-pulley countershaft drives, duplex clutch pulley countershafts and single-pulley drives with internal frictions have long been generally used, but the single clutch pulley for power drive in machine tools is of comparatively recent development. Possibly the relatively low horsepower requirements of the earlier machine tools may have caused designers to pass over this problem lightly. At any rate, it was the development of the automobile and the tractor that provided the incentive for the development of the present-day disk clutches with high capacity, smooth action and precision of workmanship.

The older arrangements were costly to install and costlier to maintain, and the adoption of the method of driving by means of a single belt with the clutch pulley located on the machine marks a considerable improvement. There are many advantages to be gained by this procedure. The machines may often be sold without countershafts, because many installations can be arranged to be driven directly from a convenient lineshaft. A clutch operating lever can be fitted to the machine in a more convenient location than the overhead belt shifter and, in addition, a clutch brake may be controlled by the same lever.

A typical clutch pulley application of a disk clutch, originally developed for the tractor industry, is shown in the accompanying illustration. This type of clutch is quite generally used for road-building and material-handling machinery. It is built in single- and double-plate types of various sizes. A feature of the device is found in its method of adjustment which utilizes the spring-seated locking pin commonly used in dividing



Disk clutch pulley for machine tools

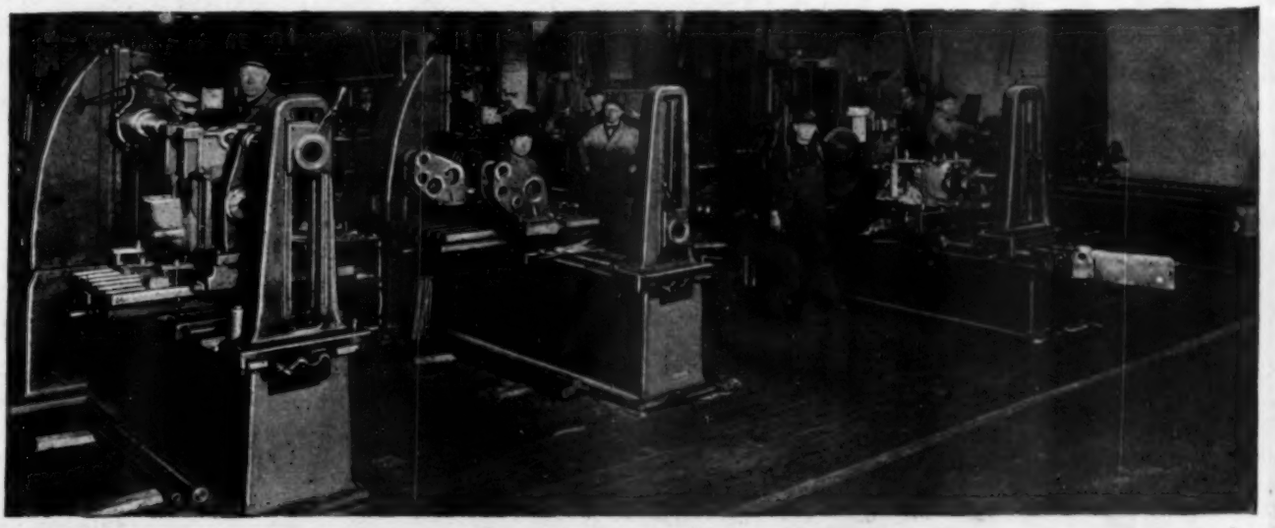
heads. This adjustment can be made without tools and the construction is such that equal distribution of the engaging force to all levers is insured.

Disk clutches of this design have been found to be positive in action and always entirely in or entirely out of engagement. They are not dependent on a spring for the engaging pressure as are the automobile type of disk clutches, and are therefore easier to operate. A considerable amount of data regarding the capacity of this type of clutch is being collected and its use is becoming quite popular.

A spring balance in which the "spring" consists of a solid metal bar over an inch in diameter is used by the Bureau of Standards as an aid in calibrating testing machines. Contrary to the usual custom, it is the "spring" that is to be tested the weights being known to a few hundredths of a pound. This bar is tested under various loads up to 100,000 lb. and its change in length for each load is measured with an extensometer. It can then be put into a testing machine, and by noting the readings of the extensometer the force being applied by the machine can be measured and compared with the machine's own readings.

Where Machine Tools Are Made

Reed-Prentice Company
Worcester, Mass.



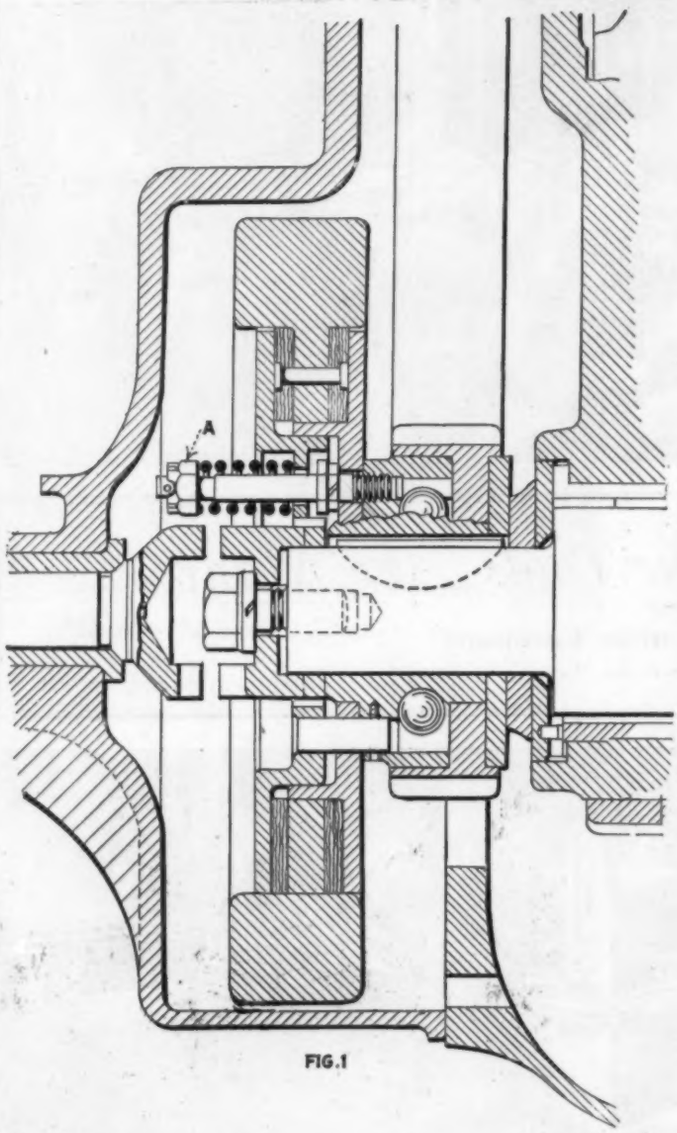


FIG.1

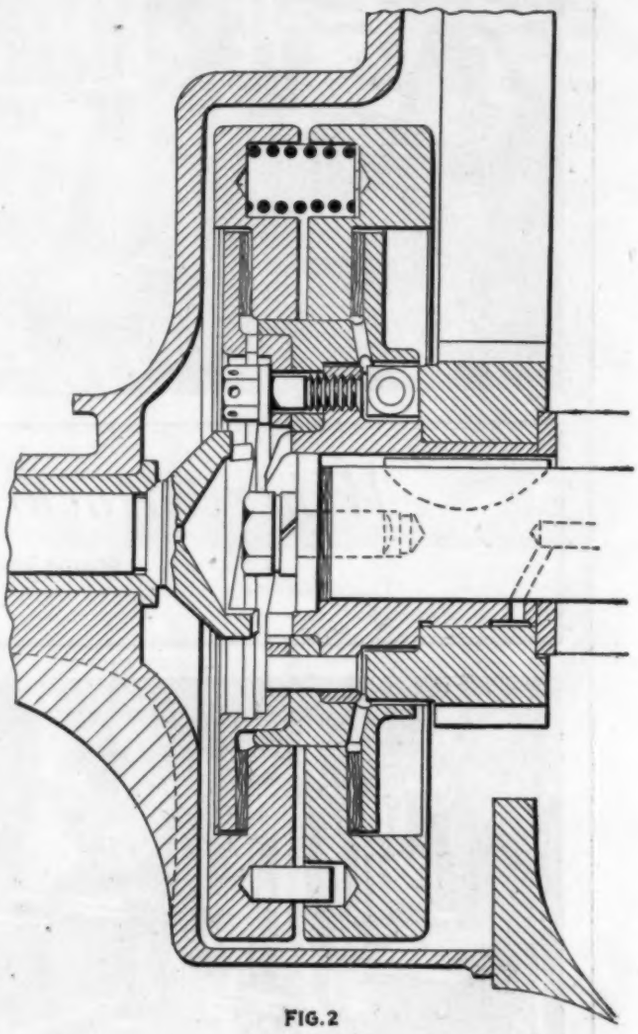


FIG.2

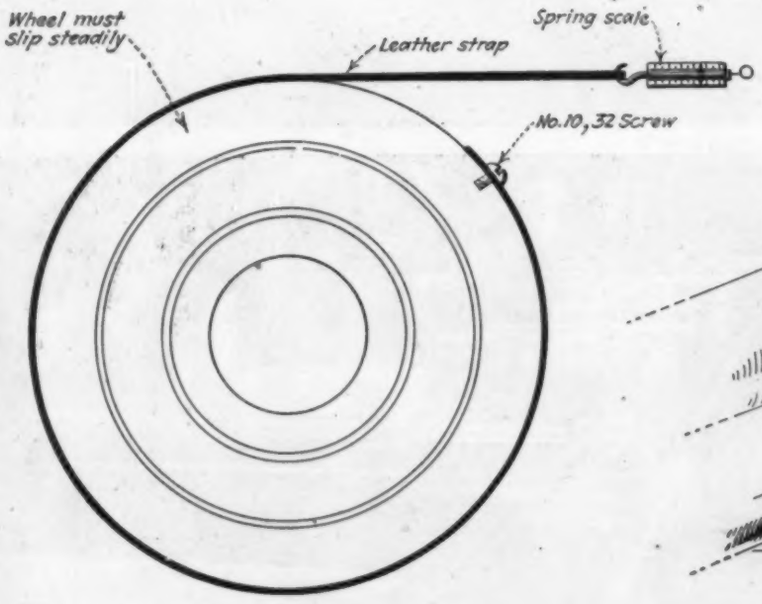


FIG.3

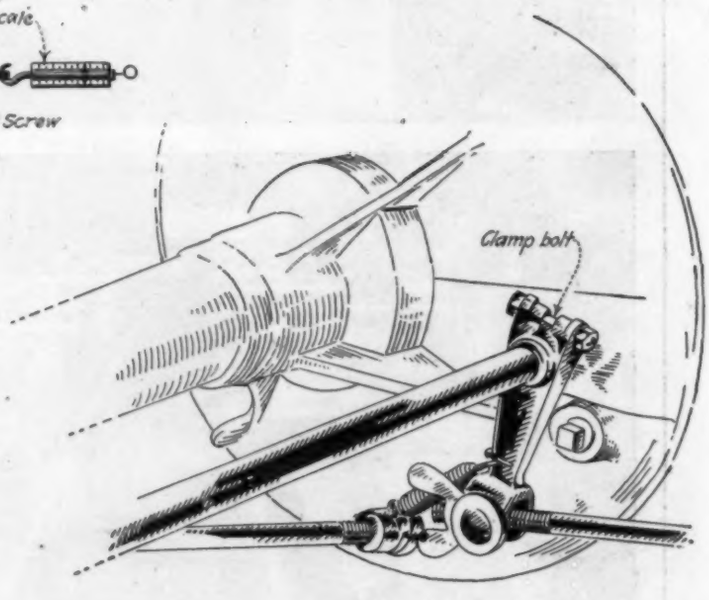


FIG.4

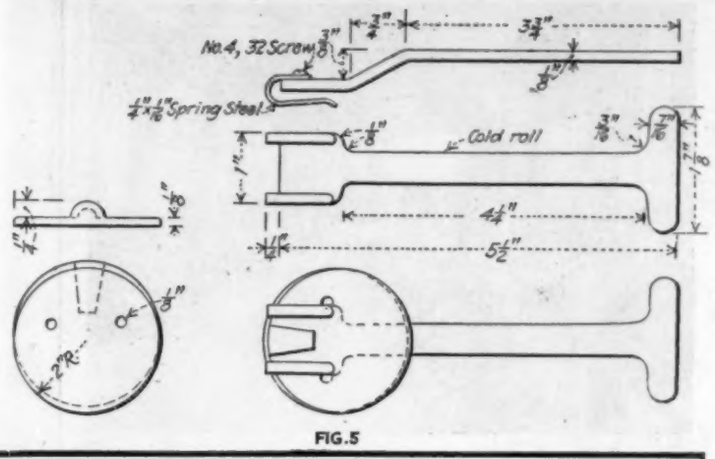


FIG. 5

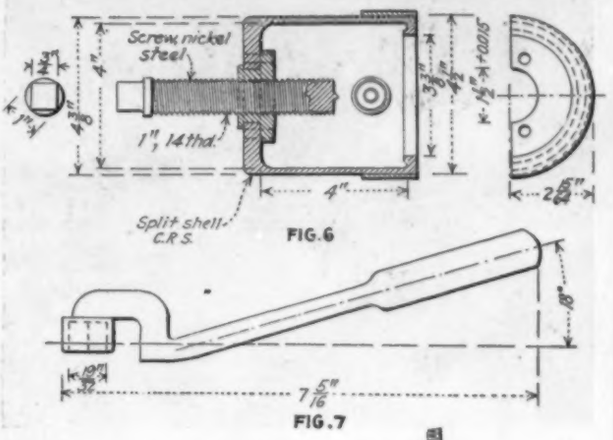


FIG. 6

FIG. 7

Pierce-Arrow Service Station Devices

Fig. 1—Construction of vibration damper

Fig. 2—Another model of damper

Fig. 3—Testing slip of damping wheel

Fig. 4—Brake rod adjustments

Fig. 5—Tool for putting butterfly valve in carburetor

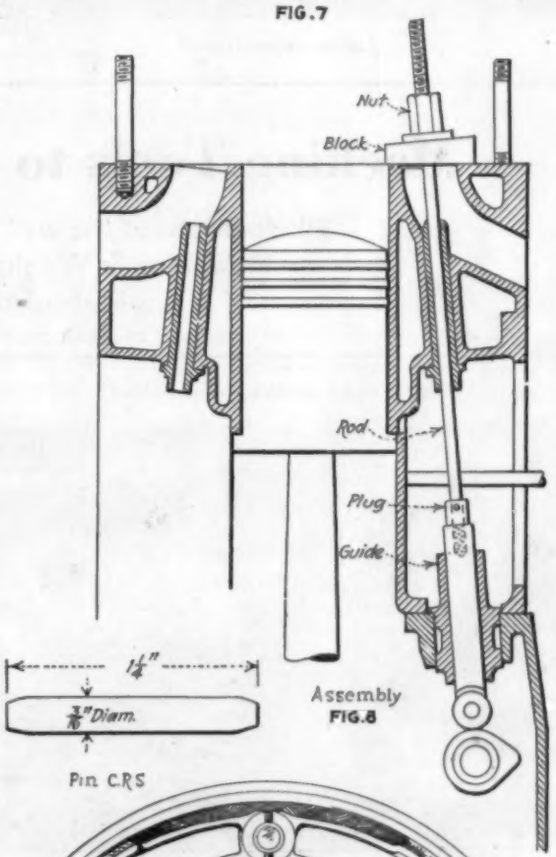
Fig. 6—Pinion gear puller—split lengthwise and held by collar on end

Fig. 7—Special wrench for cap screws over cover on water pump side

Fig. 8—Valve lifter guide remover—nut at top pulls out guide

Fig. 9—Adjustments on rear wheel brakes

Fig. 10—Details of front wheel brakes



Assembly

FIG. 8

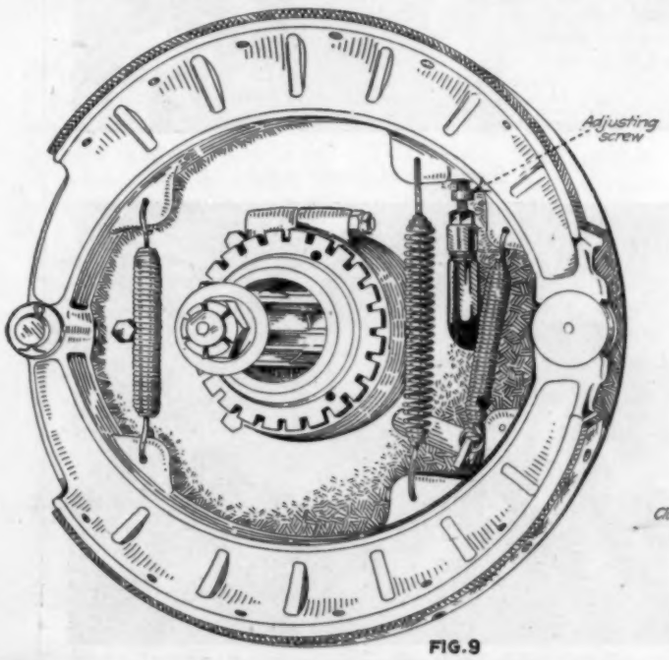


FIG. 9

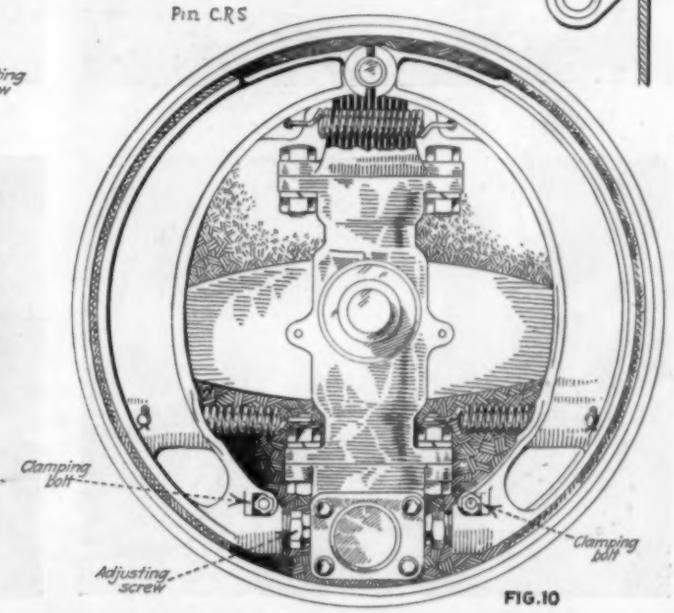


FIG. 10

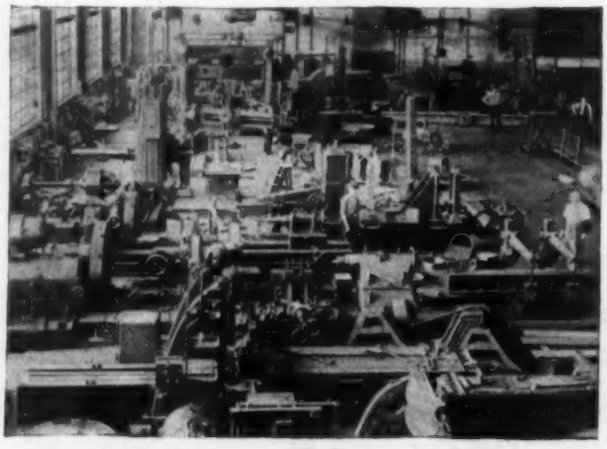
Lathe department

Toolroom—Molds and cores are made here

Machine Tools to Keep Lizzie in Shoes

Photographs of the well equipped machine shop of the Morgan & Wright Division of the United States Rubber Company

Milling and drilling department



Heavy machine department

Lettering and engraving department

Boring mill department

Automotive Production

Machining Buick Cylinder Blocks

By John Younger
Associate Editor, *American Machinist*

Six operations on the bore produce polished surface—Use of station-type milling machines—Care taken in eliminating effects of casting and machining stresses

THE Buick Motor Car Co. stands out as one of the leading examples of car makers noted for quality of workmanship and many machine tool people are of the opinion that Buick machine operations are considered as very nearly the last word in perfection.

On a casual trip through the factory one is impressed with the care that is evidently taken not only in machining work but in arranging the machining so that material will flow smoothly in orderly progression. We were given the privilege of selecting one subject for analysis, but this was somewhat difficult to do because there seemed to be so many fields that one could study. However, after some consideration, the cylinder block was taken as the most typical unit.

Cylinder Castings Are Aged

The cylinder block is a gray iron casting and as received from the foundry it is thoroughly dressed but there has been no annealing or other treatment beyond a small amount of ageing. This period of ageing varies naturally with the varying demands between the foundry and machine shop. It is worth noticing that no water test is placed on the cylinders as received from the foundry, the Buick company believing that the proper stage for the water test is after the machining has been completed.

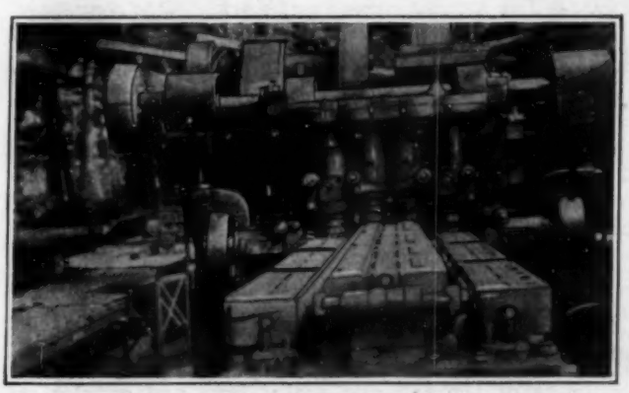


Fig. 1—Planer milling which is being superseded

Two processes are used for the first machining operation which mills the bottom and one of the sides simultaneously. The first method is to use an Ingersoll planer-type milling-machine and clamp down the casting on a table in the usual way, milling a number of surfaces at once. This is shown in Fig. 1. A more recent and better way is shown in Fig. 2. In this a 108-in. Ingersoll rotary miller is used. There are two stations on this machine, one on each side, and a man at each of these stations loads and unloads the machine as it travels so that there is a minimum of lost time due to cutting air—the machining is practically continuous between whistle times. This method has superseded the others. It is actually a roughing process, about 0.005 in. of material being left for final finish cutting.

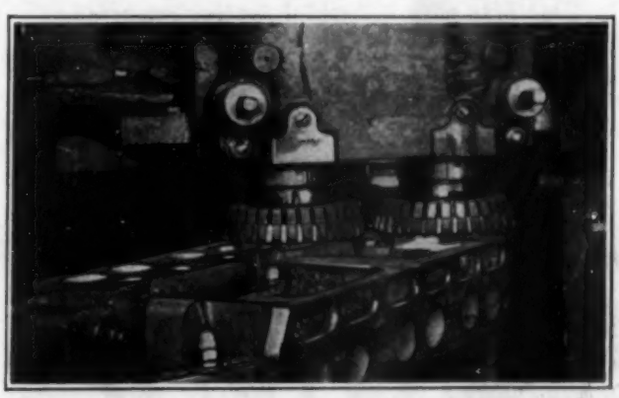


Fig. 2—Milling on the rotary Ingersoll is found to be most economical

Then, in proper sequence, come another milling operation on a slightly smaller Ingersoll rotary miller in which the top is finish-milled; the drilling of practically all holes, top, bottom, cover and sides on a five-way Foote-Burt drill; and the drilling and reaming

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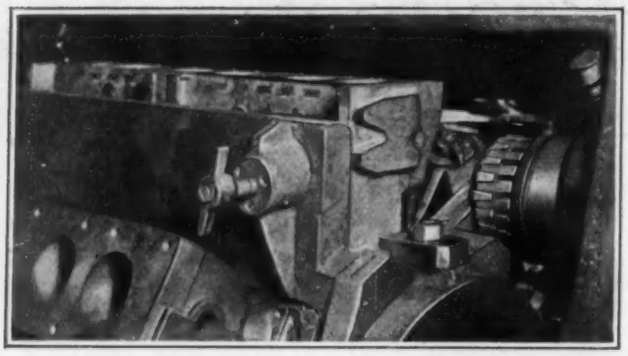

Fig. 3—Rotating drum fixture used on Ingersoll mill —front and back ends done simultaneously

of two locating holes in a modification of a standard radial drill. The core plug holes are then finished off and plugs fitted in place, which brings us to the seventh operation, shown in Fig. 3, when the end faces of the cylinder are milled on an Ingersoll machine using a rotating drum fixture. The use of this type of fixture

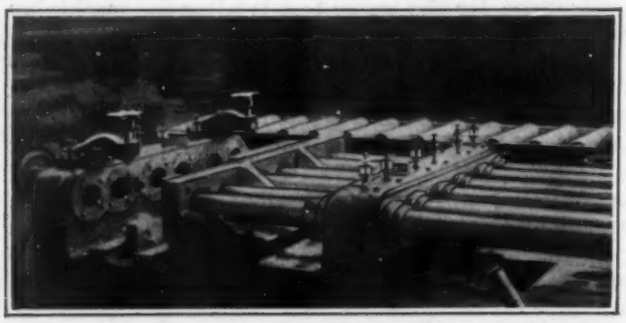

Fig. 4—The Buick straightening machine is actually a machine with horizontal floating reamers

is increasing very rapidly as it lends itself not only to the continuous milling of surfaces but to a very convenient handling, on and off, of the pieces that are being machined.

Foote-Burt drills finish drilling and milling the remaining holes that were too close to the others in the previous operation and then a four-way machine taps the holes. All this work is done before any attempt is made to bore the cylinders.

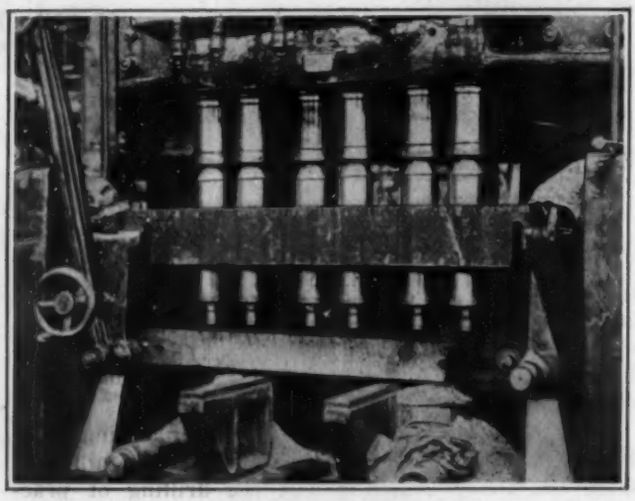

Fig. 5—Removing 0.009 in. from the bore by floating reamers

This brings us to the first boring of the cylinder, operation No. 9, which is done on a six-spindle Foote-Burt with the usual type of roughing tools. The tenth operation is interesting — it is called "straightening" and is shown in Fig. 4. It is really a refinement on the previous boring operation and is done on a special machine developed by the Buick Motor Car Co. This is a six-spindle horizontal type of boring machine, the spindles being free to float slightly. The spindles are in reality Kelly boring bars and they remove 0.055 in. leaving 0.035 in. for removal by subsequent operations.

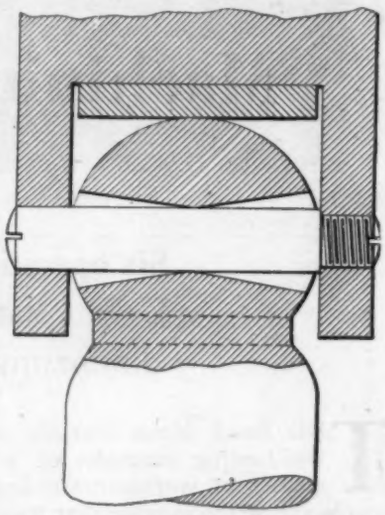

Fig. 6—Ball and socket reamer drive

Now note that the cylinder bore is left to itself for a few operations such as chamfering the bottom of the cylinder bore in a Moline Hole Hog drill press. The cutting of the clearance for the valve guides and finish milling of the bottom face of the cylinder block with a very light cutter is done on a 60-in. Ingersoll rotary miller. This brings us back to operation No. 14, done on another hole-straightening machine of a six-spindle horizontal type as before where 0.025 in. is taken off and only 0.010 in. left.

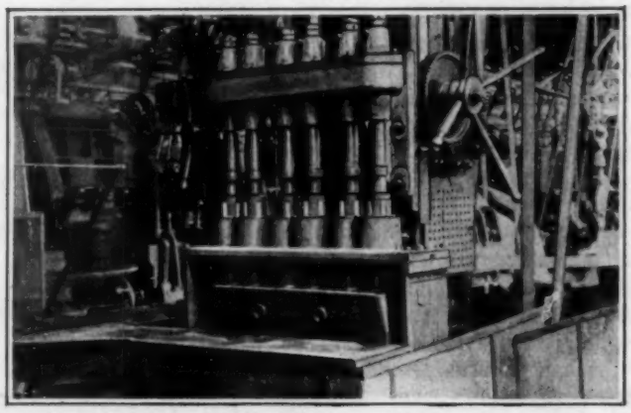

Fig. 7—The honing machine at work. Note conveyor

For operation No. 15 the cylinders leave their horizontal position and are finish reamed on a six-spindle vertical Foote-Burt as shown in Fig. 5. A special floating spindle of Buick design, as sketched in Fig. 6, is used to drive the shank of the reamer. This connection is of the ball and socket type and couples up the driving spindle with the reamer proper, allowing

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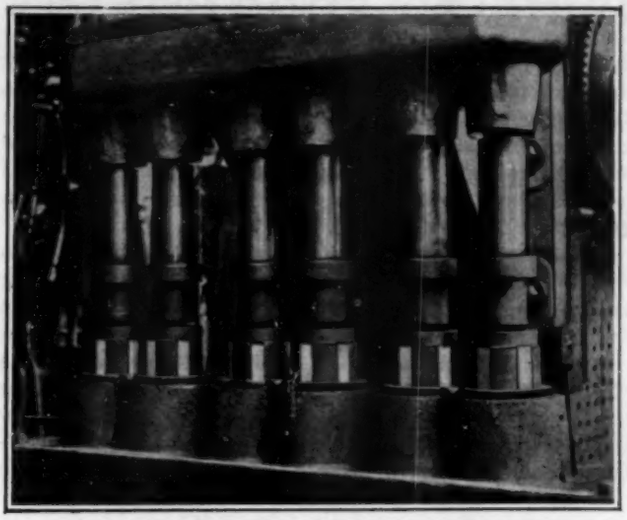

Fig. 8—Close up of the honing machine

of a slight floating of the reamer to insure accuracy in the cylinder walls. The reamer shown is of the eight-blade adjustable type. It is also interesting to note in passing that the Buick Co. found tempered spindles of alloy steel best for driving the reamers. This, the fifteenth operation, takes off 0.009 in. leaving finally 0.001 in. for finish.

Then comes another jump from the cylinder bore while the combustion chamber portion is bored on a 10-D Moline "Hole Hog." This is only a short intermission as operation No. 17 brings us back to honing of the cylinder walls in a specially adapted Foote-Burt 6-spindle machine carrying hones instead of cutting blades in what would normally be a boring-bar. This machine is shown in Fig. 7 and a close-up in Fig. 8. Two operations are completed here, the first honing by medium carborundum sticks and the second in the same machine after the cylinders have oiled up a little bit, the honing completed by a fine carborundum stick. This operation takes off about 0.0005 in. bringing the cylinder bore down to its limit 2.999 in. to 3.001. No one bore is permitted to vary more than 0.001 inch.

This practically completes the machining of the cylinder block except that at this point it is washed thoroughly in a Niagara No. 80 machine and is water tested

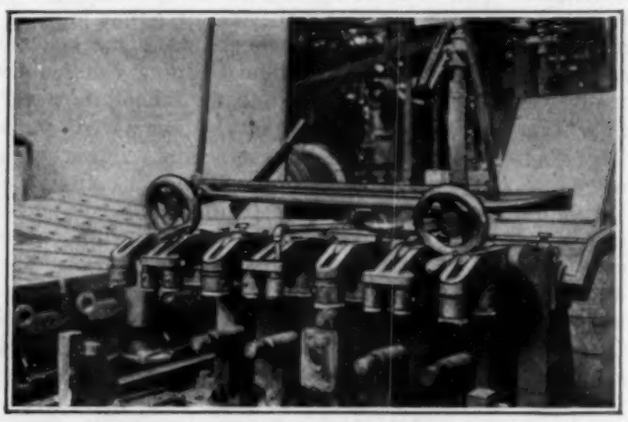

Fig. 9—The water test fixture awaiting cylinders

in a special fixture shown in Fig. 9. The water test checks up for any casting troubles or any places where the machining has gone in too deeply. Finally there comes the inspection and cleaning before delivery to the engine assembly.

For final inspection it has been found that gages of the spherical-ended type are much more accurate. The gaging surface is part of a true sphere approximately 3 in. in diameter, there being a number of gages each varying by a fraction of a thousandth to keep to the variation in the cylinder bore. One other point that is worthy of note during this gaging process is the high order of smoothness obtained on the walls of the cylinder as a result of the final honing operation.

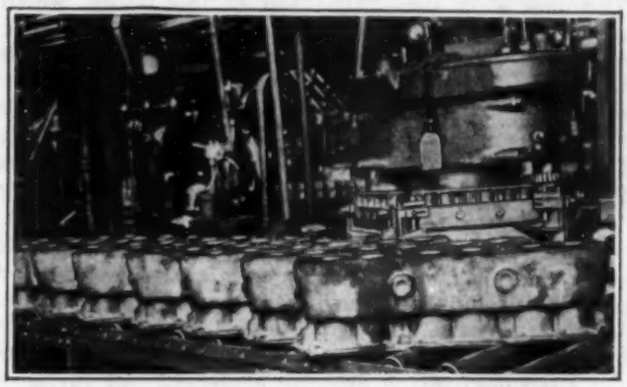

Fig. 10—Conveyor systems are in use everywhere

Surely this very smooth surface adds to the life of the mechanism and may have actual influence on the prevention of formation of carbon in the combustion chamber. At any rate, there is no question but that the smoothness does add to the life or time this cylinder will operate before grinding becomes necessary.

Finally it should be noted that conveyors as shown in Fig. 10 are used extensively between the different machines to transport the blocks with a minimum of manual handling. These conveyors are run throughout the machine shop where very heavy units such as crank cases and cylinder blocks have to be moved.

Standardization a Conservative Influence

In the booklet *Standardization*, published by the American Engineering Standards Committee, we read that standardization, like any other powerful tool is dangerous if misused; it may be begun too early, it may be carried too far, and it may be applied to improper fields. It is peculiarly important, with the rapidly growing interest in the practical use of standardization, that someone should be responsible for seeing that development takes place along right and reasonable lines. Standardization, if wrongly used will produce a fixity and rigidity that will impede progress; but if rightly used it will vitalize and quicken industry; for it will release the mind and imagination from the pressure of unessential detail and the tedium of meaningless variety and give the opportunity for new advances.

The American Engineering Standards Committee feel a serious responsibility not merely to promote standardization but to see that it is wisely and rightly used.

AUTOMOTIVE PRODUCTION

Abstracts

from other publications

Heat Treating Furnaces

Continuous, overfired, heat-treating furnaces have been installed recently in the plant of the Adams Axle Co., Syracuse, for hardening and drawing alloy-steel rear axle shafts for automobiles. They are 40 ft. long and have hearths 3 ft. wide. The work is carried through the furnace on two rows of carrier blades of Nichrome alloy steel. The top of the blades, which are 8 in. long, are engaged to take three axle shafts. With this spacing the shafts move along the hearth 2⅔ in. apart, or 4½ shafts per lineal foot. The conveyor is operated at a speed of one foot per minute, so the capacity of the furnace is 4½ axle shafts per minute. The work is placed on the blades by hand. At the discharge end of the furnace the shafts slide by gravity to a quenching tank 4 ft. wide 4 ft. deep and 15 ft. long. The conveyor carries the shafts from the tank at an angle and discharges them to a gravity transfer table which delivers them to the charging table of the drawing furnace. A temperature of approximately 1,675 deg. F. is maintained in the hardening chamber and 1,100 deg. in the drawing chamber. All furnaces were designed and built by the Strong-Carlisle-Hammond Co., Cleveland, and are equipped with Leeds & Northrop temperature regulators. Two illustrations show the furnace fronts and the conveyor out of the quenching tank.—*Iron Age*, Aug. 28, 1924, p. 509.

Lathe Work

B. M. Ikert points out how necessary the lathe is as a general tool in the repair shop where a great variety of work is handled. An automotive shop is called upon to constantly perform operations that in a sense belong to the full fledged machine shop. Sharpening and grinding reamers can be done with special adjustments, to illustrate one special advantage. Sometimes large jobs such as pulleys or flywheels come in and then the gap-bed type of lathe is a decided advantage. —*Motor Age*, Aug. 28, p. 15.

Material and Parts Control

Geo. B. Babcock contributes article No. 4, "Building Holt Tractors under Scientific Management," dealing specifically with the system of material control developed at the plant. This depends upon the production program adopted by the executives of the company based on the accepted demand for the product. The accepted demand is plotted out by months and from it the manufacturing program is laid out.

It does not follow the sales program, since the material is put through the shop in lots, and there is a minimum size of lot that it is economical to manufacture. Furthermore, as the demand is somewhat seasonal, an adherence to the sales program would overtax manufacturing facilities at one time, and leave the shop short of work at others. It is desirable to build up the supply of tractors sufficiently in excess of the demand at the early part of the program to supply the demand in excess of manufacture at the peak of the sales program, and then to decrease the volume gradually as the sales fall off, so that there will not be an excessive inventory at the end of the program. This permits manufacture at a fairly uniform rate over a great part of the program.

The article is very complete with charts and diagrams showing the forms and routine for ordering, receiving and storing material. The chart that is used to keep track of operations is also shown. This is based on the same principle as one used by Mr. Babcock at the H. H. Franklin Manufacturing Co. This pre-planning is the whole secret of the success of the Holt company in controlling production.—*Management & Administration*, Sept. p. 265.

New Method of Gaging Nut Slots

A method of gaging the position of slots in castle nuts has been submitted to the Screw Threads Division of the S.A.E. by E. H. Ehrman of the Studebaker Corp. This method permits of as much variation in the location of the cotter pin hole in the screw as it does in the location of the cotter pin slot in the castle nut.

An illustration shows the gage used. It is stated that the diameter of the gaging pin is intended to be the mean of the width of the slot in the gage and the diameter of the cotter pin. The drill-rod size nearest this dimension, but larger, is used. The diameter of the slotted part of the gage plug is made smaller so as to clear the burrs occurring in blanking and slotting the nut.

It is recommended that this proposed method of gaging should be tried out by several manufacturers before final adoption.—*The Journal of the S.A.E.*, Sept. p. 185.

Automobile Trade School

This article by S. T. Charles has illustrations of the Detroit Auto Painting School, the Michigan State Auto School and the McSweeney School at Kansas City.

The trade school is not of recent origin, but in the automotive field it is now recognized as being superior to other means of obtaining the training that is necessary in this modern era of competition. Our colleges and universities have had manual training courses for many years. The automobile trade school, however, is a type of school that cannot be compared, much less classed with the manual training course of a college or university. It is a school that in many ways is unique, as the mechanics are trained with equipment that they will actually come in contact with, duplicating conditions that actually exist in service work. Another advantage of such training is that the hand is educated as well as the head. Still another advantage is that fundamentals of business are combined with manual training so that one is completely equipped to venture into the service business on his own initiative.—*American Automobile Digest*, Sept., p. 33.

Methods of Machine Tool Design

By A. L. DeLeeuw
Consulting Editor, *American Machinist*

Factors affecting the design of machine tool frames—Strength and rigidity — Cumulative vibration and its elimination — Webbed and box-section construction for machine frame parts

AS IN any other kind of machine, the frame of a machine tool must be sufficiently strong to stand any load it may have to carry or any stress it may have to endure. The main difference between the frame of a machine tool and other classes of machinery lies in the fact that the loads and stresses in a machine tool can only be guessed at more or less intelligently. Consequently the frame of a machine tool must be made heavy as compared to the frame of other machinery.

This requirement is not at all troublesome because there is another condition which must be fulfilled and which would provide a frame heavier than that required to obviate breakage. This condition is that a machine tool must be extremely rigid. It must not be subject to deflection to any appreciable extent. Such important members as, for instance, the propeller shaft of a large ocean-going steamer, are permitted to have an appreciable amount of torsional deflection—so much so, in fact, that in some cases the amount of deflection is measured for the purpose of determining the amount of horsepower generated by the engine. It stands to reason that this deflection could not be made the basis for such a calculation unless it is quite an appreciable amount. Nevertheless, this relatively large amount of deflection causes no trouble and is perfectly permissible. A similar amount of torsional deflection in a lathe bed would be out of the question. No accurate work could be done with a lathe where the torsion of the bed is so great that its amount could be used to determine the amount of power taken by the machine.

Still another condition to be fulfilled is that a machine tool must not only be free from vibration but must also be so constructed that it kills vibration caused by the work. We have, then, altogether these three requirements which must be met in practically any machine tool: sufficient strength, great rigidity—which is the same as saying very small amount of deflection—and a tendency to absorb vibration.

Vibration From Cutting Tool Action

There is in any machine tool a strong tendency to set up vibration by the cutting action of the tool. Although a superficial look at the chip may give the impression that the action of cutting is continuous, a closer observation will reveal the fact that it is composed of a large number of small pieces of metal which have been pushed over each other. Apparently there must have been an intermittent action, because the tool must have separated one of these small leaves before it began to act on the next one, or at least there must have been a reduction in the pressure the moment one of these leaves was completely separated from the work. Fig. 227 shows a stress diagram as it would appear if a leaf were completely separated before the next leaf was attacked by the tool. In this diagram the stress varies from zero to a maximum, but conditions are not quite so bad as this—at least not as a rule. When one of these little leaves is split off from the work it bears up hard against the next piece to be split off, so that the true diagram of variation of stress would be more in the nature of Fig. 228, where the extreme variations are somewhat ironed out. However, we can see readily that there must be a difference of pressure during the cutting, so that high and low points will appear every time one of the leaves of the chip is split off.

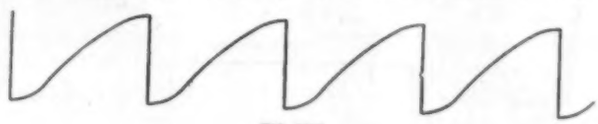

FIG. 227

FIG. 228

Fig. 227—Diagram of cutting stress with each leaf of chip independently separated. Fig. 228—Closer approximation to true stress diagram

This periodic change in pressure causes vibration of tool, work, and machine. These variations take place a great many times a minute, the number of times depending on several elements. To mention a few, it depends on the size and shape of the cut, on the shape of the tool and its angles, and on the hardness or toughness of work.

We can imagine a tool so supported in a machine that, if it were struck with a hammer, it would vibrate the same number of times per minute as the number of vibrations caused by the variation in stress during cutting. In that case the effect of these vibrations would be cumulative and the tool would break in a very short time.

It is perhaps not out of place to enlarge somewhat on what is meant by this cumulative effect and why it may appear at one time and not at another. A good way of visualizing this effect is to imagine someone sitting in a swing and someone else standing behind and pushing it. If this push is delivered at the exact moment when the swing begins to reverse its motion, the amplitude

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will increase. The swing will make wider and wider arcs. This is the cumulative effect of these various pushes. We may imagine that the person behind the swing has timed the movement of the swing perfectly and has brought his body in unison with the swing; or again we might imagine that the man behind the swing does not move his arms exactly in unison with the swing. In the first case he delivers the push at just the right moment; in the other case he will sometimes help and sometimes retard the swing. There is an interference of the motions of the swing and the man and the result may be a killing of the uniform vibrations of the swing. There may be a time when he helps and another at which he retards the movement. In either case he will break up the uniformity of the vibrations, and there will be no cumulative effect.

The swing has a period of vibration of its own, depending among other things on the length of the ropes or chain by which it is suspended. This period

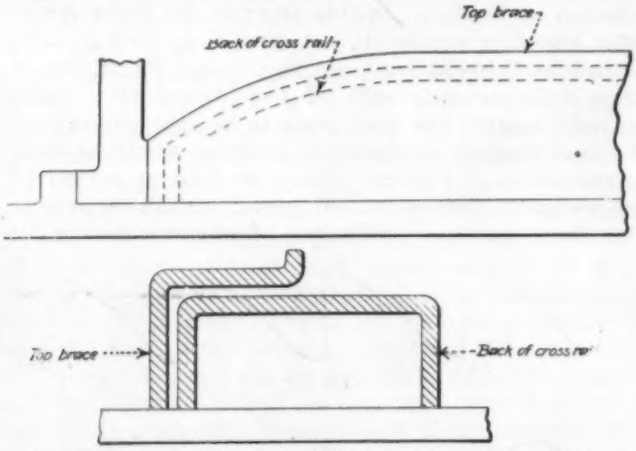

Fig. 229—Ribbed construction for planer top brace

of vibration cannot be changed because it is an inherent quality of the swing. Anything at all which can be set in vibration has such an individual period. If there is some external force applied to such a body in such a way that the period of application of that force corresponds with the individual period of vibration of the object, then there will be a cumulative effect, and the result may be anything from the production of a musical tone up to a complete disruption of a heavy piece of machinery.

A machine member may be so constructed that it has an individual period of vibration. When the member is of a simple form, such as a shaft or spindle, it has such a period; when it is of a more complicated form, such as a cored cast-iron member, it may or may not have such an individual period of vibration. Though the entire cast-iron member may not show this individuality, it should not be forgotten that it is composed of a number of webs and ribs and that each of these individual parts may have such a period of vibration. When this is the case trouble may result if there is a cumulative effect, but it is not very apt to happen, because it is more than likely that the individual period of vibration of one part of the casting interferes with that of another part, so that the vibrations are disrupted or vanish.

We have in a machine tool members which may be set in vibration and may have an individual period of vibration. There is also some action going on—the cutting, in this instance—which has a tendency to set up vibration. Consequently, when there is any member in a machine whose period of vibration corresponds to the number of vibrations set up by the cutting action, there will be a cumulative effect which may cause either the production a disagreeable noise or excessive vibration of some part of the machine. This action may spoil the work, or it may cause the tool or a machine part to break.

It would be remarkable indeed, if the vibrations set up by cutting correspond in number exactly with the individual period of one of the machine elements, that is, if the number of vibrations caused by the tool were always the same. This number of vibrations set up by the tool changes continually. It is modified by the depth of cut, by the feed, by the sharpness and smoothness and shape of the tool, and other elements. The result is that at one time or another the tool is almost certain to set up vibrations which are answered by some part in the machine.

We have all noticed how, when rough-turning a shaft, we may have chatter on one side and not on the other. This chatter is merely the cumulative effect of the vibrations set up by the tool. They are cumulative on one side of the shaft and not on the other because on that side the cut is of such a depth that the period of vibration set up by the tool corresponds to the natural period of the shaft, or perhaps of some machine part. The period set up on the other side of the shaft is not in unison with the natural period of the shaft.

It would seem from the foregoing that it is not possible to eliminate this cumulative effect of vibration and, as a matter of fact, chatter that may be found very hard to eliminate will appear under certain conditions. However, one condition that helps materially in obviating this disagreeable effect of the cutting action of a tool is found in the fact that large masses of more or less heterogeneous material have a tendency to dampen vibrations. Though a pendulum would keep on swinging in air, its vibrations would soon come to an end if it were submerged in water or oil. The movement of the pendulum through the water makes it perform work that absorbs the energy of its vibrations.

Cast-Iron Parts Resist Vibration

Similarly, when an effort is made to set a heavy mass of cast iron in vibration, the result will simply be that the effort is spent in doing work on the cast iron, shifting its particles and resulting finally in heat, but the mass of cast iron itself has not been set in vibration. A similar mass of steel or bronze, which is of a more homogeneous character, might have been set in vibration. Such a mass of cast iron cannot easily be made to vibrate, and it will also kill the vibrations of some member in close contact with it, much as the piece of felt in a piano stops the vibrations of the strings.

It is this desirable quality of cast iron, its heterogeneity, which makes it particularly valuable in machine tool construction. In many cases cast steel might be substituted for parts of a machine tool frame at a cost which would not be out of keeping with the value of the machine, but it might not be advisable to do so because we would invite cumulative effect of the vibrations.

Cast iron is the accepted material for the frames of machine tools and the use of other materials is an exception. The greatest objection which might be

raised against the use of cast iron is its limited strength but, as we have seen before, when enough of it is used to obtain the necessary rigidity, there will certainly be enough to give the required strength. Its chief advantages are that it is a comparatively cheap material and may be worked easily; that it has a tendency to kill vibrations; and that it will give great rigidity as compared to its strength. A lathe bed might be made much lighter of cast steel and yet have the strength of the cast-iron bed, but its deflection would be greater, it would not have the tendency to kill vibrations, and there would be great danger that it might be set in vibration itself.

Steel Tool Rests and Cast-Iron Spindles

Where there are parts of a frame subject to heavy stresses per unit of area, cast iron is no longer the best material. It may therefore be necessary to construct the tool rests in machines that take heavy cuts of steel.

Though we are not dealing just now with spindles and similar parts, it should be remarked that the tendency of cast iron to dampen or kill vibrations makes this material very desirable for spindles. That very few cast-iron spindles are used is due to the fact that in practically all machine tools a spindle must run at various speeds, sometimes high and sometimes low. In order to be able to run at a high speed its diameter must keep down to a minimum compatible with other conditions. If such a spindle were made of cast iron it would not be strong enough when it is running at a low speed when, as a rule, it will have to resist heavy stresses. On the other hand, when a machine is made for a single purpose only and the speed of the spindle is not high, it is advisable to make it of cast iron. Many large single-purpose machines have been made with cast-iron spindles and have given great satisfaction. In this connection it may be noticed that the chatter so common in automatic screw machines when wide forming cuts are taken, and particularly when the feed of this cut is very light—that is, when the piece is nearly finished—is absent when such machines are provided with cast-iron spindles.

General Form of Frame Parts

Among the frame parts of machine tools which deserve special attention are lathe, planer, and grinder beds, cross rails of planers and boring mills, housings of such machines, head-stocks and carriages of lathes, saddles and swings of boring mills and planers, columns of milling machines and their knees, saddles and tables, columns of slotters and shapers, and a number of other parts. It is, of course, utterly impossible to give an analysis of all these various parts within the scope of this series of articles and we will have to confine ourselves to some general remarks about the construction of such parts. We have already seen that it is desirable to make these parts of cast iron. We will now consider their general form.

Not so many years ago the general practice was to make all the elements of machine tool frames of ribbed construction. Perhaps one of the main reasons why this was done was that at that time machine tools were built and not manufactured. A large portion of the cost of a machine was in the pattern work, so that one of the main considerations of the designer was to construct the machine elements so that a minimum of pattern work would have to be done and this could best be accomplished by making the machine parts of the ribbed construction. Cores and core boxes were avoided as much as possible.

Nowadays the box construction is the accepted construction for machine tool elements. Notwithstanding that this construction is now considered to be the best, many elements of machine tools approach this construction only to a limited extent. Lathe beds, for instance, are not yet made of true box construction, though in some heavier lathes this construction is closely approximated. The main reason why a lathe bed is not made of true box construction is that this would not leave means for getting rid of chips. In the design of most other kinds of machines of standard type, the most important considerations are always put in the foreground and the so-called practical considerations, such as accessibility, ease of repair and similar items, are considered of secondary importance. In machine

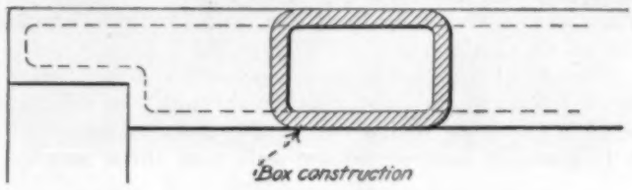

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Fig. 230—Planer top brace with box section

tools this order is often reversed; practical considerations are considered first and the main elements of the functions of the machine are given a second place. Although this condition is not to be recommended, it is easy to see why it should be so. A turbine, for instance, will run possibly for many years without ever requiring the attention of the engineer except for its regular operation. A machine tool, on the other hand, requires attention all the time. There are continually shifting conditions, different kinds of work, small adjustments and repairs, etc., which would make the machine anything but practical unless provision is made to meet these conditions in a simple manner.

As an example we mention again the lathe bed which is made open top and bottom merely to get rid of chips, and the prime requirement of constructing the bed so that it shall have the greatest possible strength and rigidity is overlooked. Many times this giving of preference to practical consideration goes entirely too far. Not so many years ago the universal practice was to construct the top brace of a planer or boring mill as an arch, the curvature of which corresponded to the curvature of the back of the cross rail, as shown in Fig. 229. The ribbed construction made it easy to cast and required a minimum height, because the same height occupied by the cross rail was also occupied by the top brace, with the exception of the top web. The writer remembers well how he met considerable opposition when first he made the top brace of box construction, as in Fig. 230. The objections were not that it was an inferior top brace, but that it required cored work and the machine would be slightly higher.

This instance is mentioned to bring out how wrong it is to let the so-called practical considerations predominate at the expense of the essential requirements of the machine. Here we should modify Brutus's speech and say not that we consider the practical requirements less, but that we consider the essential requirements more.

Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

Two Ingenious Milling Fixtures

By Jack Williams

A couple of ingenious fixtures used in making the "Positive Grip" spring collets manufactured by the J. M. Ney Co., Hartford, Conn., are illustrated herewith. They were designed by Emil F. Pfunder, engineer with the above company.

The collet blanks are made in a screw machine. Three large holes are then cut radially through the shell at what is to be the spring end of the collet by means of a trepanning tool, or hollow mill, and three smaller

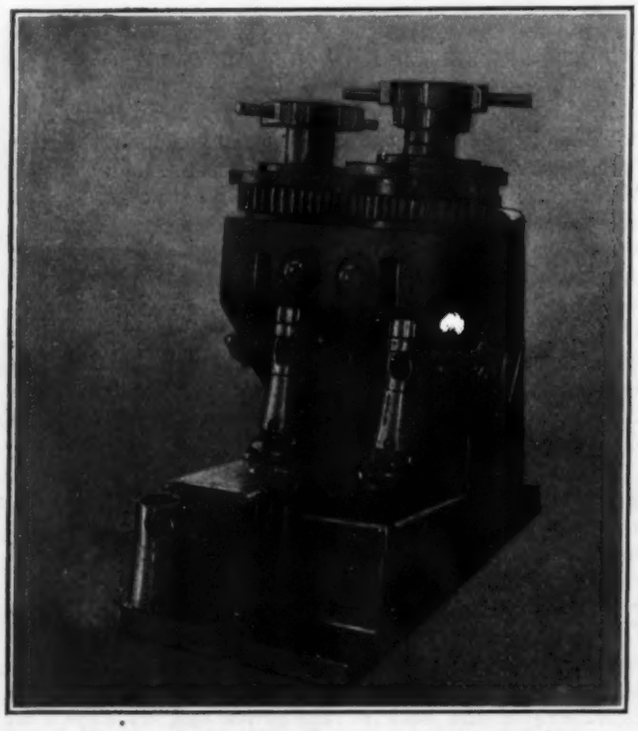


Fig. 1—Milling fixture for opening the collets

counterbored holes are made at the jaw end. The smaller holes are incidental to the manufacture of the collet and the metal surrounding them is cut away in the second milling operation.

With the work in the first fixture, Fig. 1, the table of the milling machine is fed forward to bring the work against a pair of slitting saws which are sunk into the work without vertical traverse. They cut a kerf from the large trepanned hole at the upper end to the counterbored hole at the lower end, going clear through to the center-hole of the work. After the work pieces have been located with reference to the holes the locating plugs are withdrawn and the spindles are held against rotation by a latch and index-plate attached to each of the gears. The work is positioned for the second and third cuts by withdrawing the latches and rotating the sleeves. Both latches are connected to one operating lever and work together.

The second fixture, shown in Fig. 2, uses the same devices for locating the work but is disposed horizontally and the cutters are fed to the work by the power traverse of the milling machine. The second fixture is not exactly horizontal, nor is the first one quite vertical. Both are inclined about 5 deg., the inclination allowing the cutters to come as close as possible to the plug centers without actually touching them.

The collets as they come to the first milling fixture, shown in Fig. 1, have an axial hole of large diameter at the spring end (the upper end as shown in the picture) and a smaller hole the diameter of which varies in accordance with the nominal holding size of the collet at the other end. Both of these holes are chamfered slightly and the fixture holds the blanks between stub centers.

The spindle of the fixtures are fitted with spring collets which grip the blanks and hold them against rotation during the cut. Since the spring ends of all collets are of the same diameter without regard to the nominal

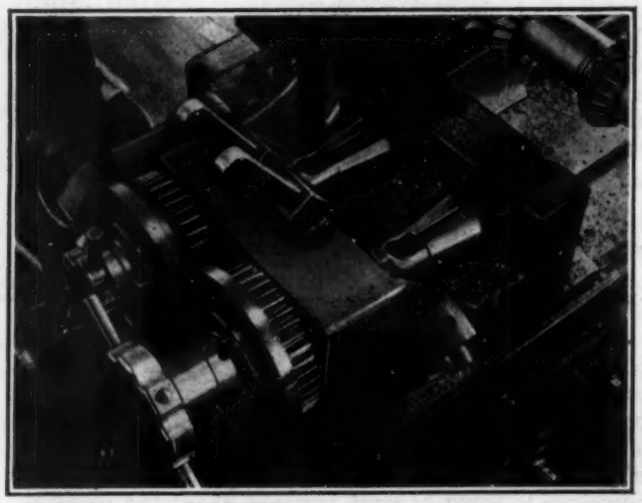


Fig. 2—Fixture for second milling operation

holding size, all sizes are handled by the fixtures without change.

The spindles are free to slide endwise through the rotatable bushings, or sleeve, to which the gears are keyed. When a piece of work is set into the fixture the corresponding spindle is pushed down until its plug center contacts with the work, the collet-jaws at the same time enclosing the upper end. In this position the cross-handle is given a partial turn, which closes the collet upon the work and at the same time binds

the spindle in the sleeve. Before tightening the collets, the work pieces are located with reference to the radial holes by means of sliding plugs. The inclination of the second fixture results in milling the jaws—not the spaces between them—parallel.

It will be noticed that the cutters of the second operation leave a thin ring of metal surrounding the plug center at the jaw end, connecting the jaws together. This ring remains during all subsequent operations on the collets, including hardening, tempering, grinding and lapping, and is cut away in a final operation on a high-speed elastic grinding wheel.

Attachments for the Milling Machine

By W. E. Buck

The illustrations show three attachments for a milling machine that were built by the writer in the toolroom of the Michigan Central Railroad shops at Jackson, Michigan.

The boring attachment shown in Fig. 1 is equipped with an off-center bar, adjustable for boring holes from one to five inches in diameter. The adjusting mechanism can be regulated in thousandths of an inch.

In Fig. 2 is shown a slotting attachment together with several pieces of work performed by it.

In Fig. 3 is shown the same slotting attachment equipped with a device for circular cutting. The tool *A* is fulcrumed at *B* and attached to the bar by the link *C*. Cuts of varying radii can be made by the use of tools of different lengths.

All the above-described attachments fit the universal head on the same milling machine and, consequently, can be used at any angle in either or both of two directions.

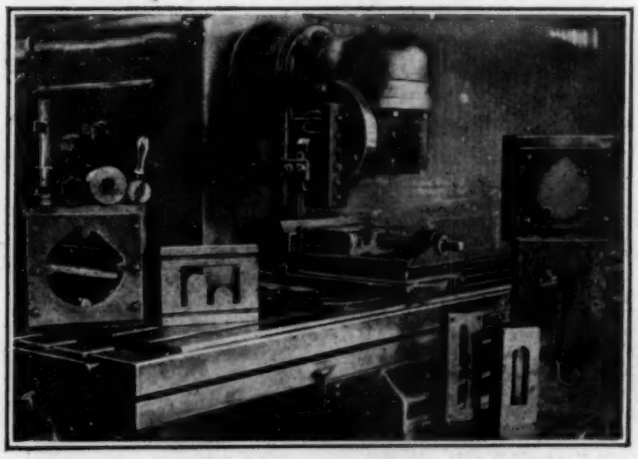


Fig. 1—An adjustable boring bar

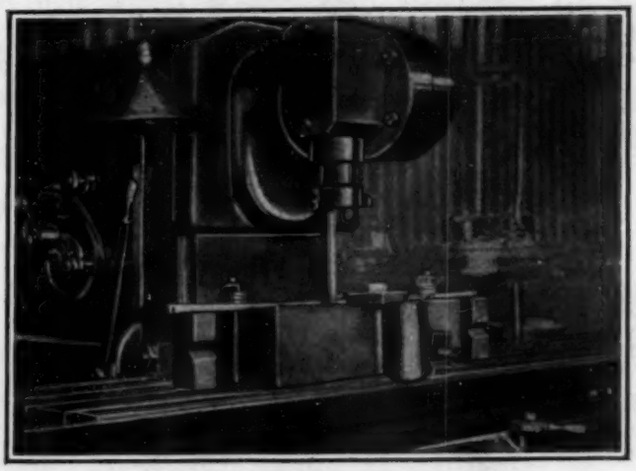


Fig. 2—Slotting attachment

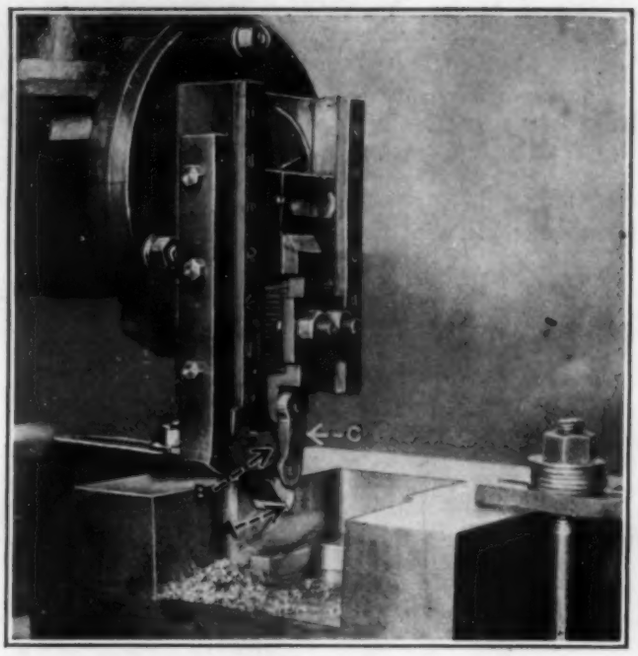
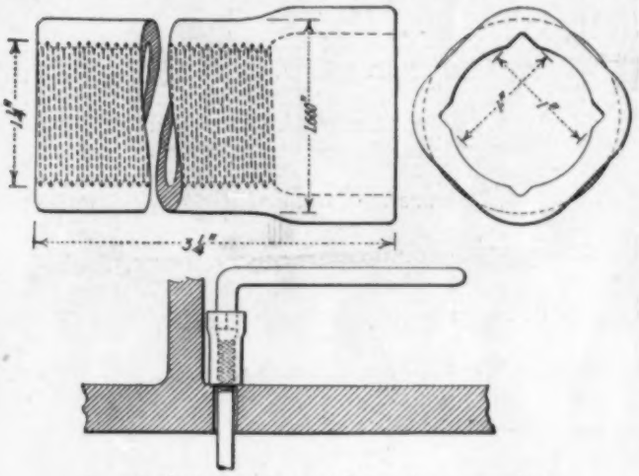


Fig. 3—Device for circular cutting

A Sleeve Nut

By B. E. Hart

In installing a new machine it was discovered that one of the holes for the foundation bolts had been drilled in the bed too close to a stiffening web to allow the use of a standard hex nut.



A nut that can be used in close quarters

Since removing the bed and drilling a new hole would avail nothing without changing the position of a well-anchored foundation bolt, it was decided to devise something to get around the difficulty. One of the men suggested making a sleeve nut from hydraulic pipe and squaring the upper part of the hole for a wrench.

The illustration shows the nut in detail and the method of application

Helps for the Draftsman

By Robt. R. Robinson

The accompanying drawings show a few things that have been found useful in our drafting room. While the drawings are practically self-explanatory a few words may help in making them clear.

In Fig. 1 there is shown an ordinary 45-deg. transparent triangle with two lines scribed across it at an

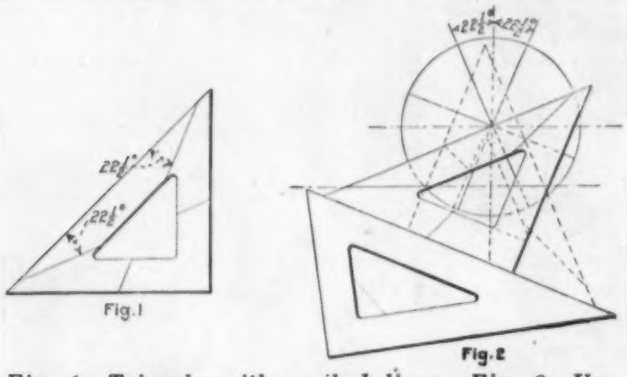


Fig. 1—Triangle with scribed lines. Fig. 2—Use of the triangle

angle of 22½ deg. with the long side, not necessarily passing through any particular point. The use of such lines is indicated in Fig. 2, the scribed lines being used in connection with any horizontal or vertical line to locate a straight edge at a 22½-deg. angle from which, as a base, divisions such as shown may be laid out.

A simple means for keeping the T-square from rubbing on a drawing is shown in Fig. 3. A bevel-edged thumbtack is forced into the under side of the blade near the head and another at such a distance away that

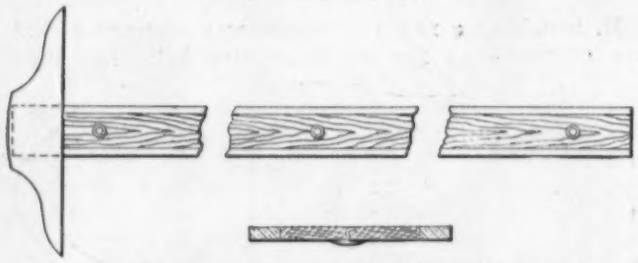


Fig. 3—A T-square that will not dirty the drawing

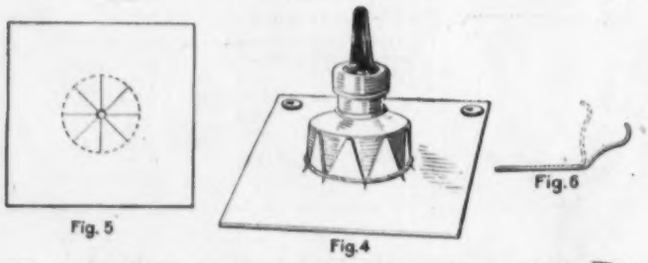


Fig. 4—A holder for the ink-bottle. Fig. 5—How the holder is made. Fig. 6—How the prongs are bent in a steel holder

it will come beyond the drawing. Other tacks may be placed at intermediate distances if required. The tacks placed near the head and end of the blade may be clinched over, but the intermediate ones should have the points filed off so that they can be easily removed. If the thumbtacks are placed approximately on the center line of the blade, it will be found that the T-square will move entirely on the heads and at the same time the natural pressure of the fingers on the upper edge of the blade will keep it next the paper when drawing a line or placing a triangle against it. On long T-squares, the weight of the head pivoting on the thumbtack nearest it will tend to bow the center of the blade slightly away from the paper and counteract the tendency to sag in the center and rub against the paper.

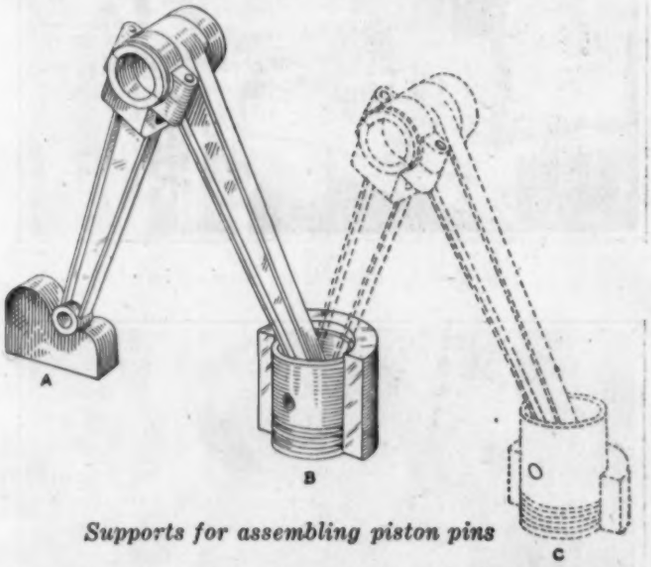
A quickly made ink-bottle holder that is convenient and reliable, especially for odd bottles of colored ink, erasing fluids, etc., is shown in Fig. 4. This holder can be made from either light sheet metal or of cardboard. Fig. 5 shows the method of making same. If made of cardboard, the outer circle to which the radial lines are cut should be the same size as the base of the bottle, so that the cardboard will tear a little as the bottle is forced in. A rubber band may be used to reinforce the holder. If made of sheet metal, the circle should be a little larger than the base of the bottle and the fingers should be bent as shown in Fig. 6. Such a holder is very convenient to use on a drawing board tilted to quite a sharp angle, as it may be tacked to any open space on the board.

Assembling Connecting Rods for V-Type Engines

By Clifford H. French

Spade, or interlocking, connecting rods such as are used on V-type engines, are a bit awkward to handle when putting on the pistons to make a sub-assembly, before going to the general engine assembly line. The Lincoln shop has a very neat device for handling this sub-assembly, as shown herewith.

Aluminum alloy pistons are used and are placed in hot water to expand them before putting in the piston



Supports for assembling piston pins

pin. The hot piston is then placed on the bench against the half block *B*. The end of one rod rests in the block *A* and the other goes down inside the piston until it matches the hole and the pin is pushed into position.

The piston already in place is moved over against the shorter block *C*, and the second piston, hot from the bath, is placed in block *B* and its piston pin put in place. The block *B* makes a very convenient support, or resistance, for the piston while inserting the pin.

The Government and the Machine Tool Industry

By Doctor George K. Burgess
Director, Bureau of Standards

A statement of the Federal agencies interesting themselves in the machine tool industry—What they do—How it is done

THE machine tool industry is one of the great industries of the country. It is largely the outcome of American initiative, engineering skill and inventive genius. It may also be called one of the most important of our key industries, for upon its development and healthy condition depend in large part the progress and economical output of several other of our largest manufacturing industries such as the automotive, agricultural machinery and electrical equipment industries, and especially in time of war, the production of ordnance material.

One cannot visit this exhibition of 1924 without being impressed with its wealth of instructive exhibits of educational, technical, scientific, and industrial importance to the community and the nation, an object lesson not only to the young men, engineers and artisans of today and tomorrow, but to all concerned with simplifying the mechanical processes of manufacture and eliminating waste or cutting costs in the operations relating to metal products.

From a Government representative, you will perhaps expect a statement of the Federal agencies interesting themselves in the machine tool industry, what they do and how it is done

Three Bureaus Close to Industry

The Department of Commerce has three great service bureaus, Census, Foreign and Domestic Commerce, and Standards, which are particularly close to industry, the first concerning itself with statistics, the second with business, the third with science and technology. There is also the Division of Simplified Practice, whose function it is to assist industry in reducing types, varieties and styles of manufactured products. The Bureau of Standards, in addition to its work of testing and experimental research, is also acting often in association with other bodies, such as the American Engineering Standards Committee and the American Society for Testing Materials, in formulating specifications for materials, performance of machines and instruments, and preparing standards of practice and safety codes.

The War and Navy Departments have, in the arsenals and navy yards, great manufacturing establishments which are vitally interested in machine tools and their accessories, such as gages, and in many problems relating to standardization. The ordnance department of the army, for example, has some 1,200 items or standard articles, 75 per cent of which are manufactured with machine tools and also owns many screw machines. As to gages, this department has now stored about one-half million having a value of $35,000,000.

The Federal government, in the Federal Specifications Board, now possesses a centralized representative body responsible for formulating and promulgating specifications for all commodities purchased by the government.

Congress in 1918 created a body of the greatest import to the machine tool industry, the National Screw Thread Commission, composed of representatives of the Departments of War, Navy and Commerce and of the American Society of Mechanical Engineers and the Society of Automotive Engineers. This Commission, which meets in New Haven Thursday of this week is about to issue its second report.

American Engineering Standards Committee

Several of the Government Departments are represented on the American Engineering Standards Committee, a national organization founded by the engineering societies and supported by them and by contributions from industrial concerns. This body has underway in its sectional committees numerous standardization projects relating to mechanical engineering and metal products. One of the most active of these sectional committees is concerned with the standardization of Plain Limit Gages for General Engineering Work, which with its subcommittees on Methods of Gaging and on Limits, Manufacture and Use of Gages is meeting in New Haven this week. There are also meetings here of the Research Committee on Cutting and Forming Metals of the American Society of Mechanical Engineers, of the Central Committee of Small Tools and Small Tool Elements, on Standardization of Tee Slots, and of Tool Holders and Tool Part Openings. Next Monday, in Boston, in connection with the annual convention of the American Society for Steel Treating, there meets the Joint Committee on Gage Steel, a group composed of representatives of steel and gage manufacturers and government representatives which is carrying out its program of research in the shops of the manufacturers and the laboratories of the Bureau of Standards.

Some illustrations among the problems in which the Bureau of Standards is interested may be instructive. In the construction and graduation of machine tools, a point of fundamental importance from the standpoint of interchangeability and international standardization

Abstract of address delivered at the opening of the fourth annual exhibition of machine tools at New Haven, Conn., Sept. 15.

is that of a standard temperature for the measurement of machine parts, graduated scales, gages, etc.

In the United States 68 deg. F. (20 deg. C.), and in Great Britain 62 deg. F. (16⅔ deg. C.) are generally accepted as the temperatures at which machine parts, gages, etc., should have their correct nominal dimensions. On the Continent, 68 deg. F. (20 deg. C.) is very generally and increasingly used except in France, where 0 deg. C. (32 deg. F.) is advocated by the International Bureau of Weights and Measures.

It is apparent that there is little difficulty from this source so long as all parts entering into a mechanism are correct at the same temperature, whether that temperature be 20 deg. C., 16⅔ deg. C., or 0 deg. C. It is equally apparent that there is bound to be trouble if some of the parts are correct at one temperature and some at another; and it should be noted that this trouble, or freedom from it, is entirely independent of the system of measurement employed. It will occur whether the measurements are made in inches or in millimeters, and can be overcome only by the universal adoption of a single standard temperature.

In view of the wide use of 68 deg. F. (20 deg. C.) there can be little doubt that this temperature should be adopted.

Mention may be made of the work being done by the Bureau of Standards along the general lines of dimensional standardization and in the field of precision screws and gages.

In co-operation with the National Screw Thread Commission and the various Sectional Committees organized under the American Engineering Standards Committee, the Bureau is taking an active part in work of this character.

Screw thread standards have been established covering a coarse and a fine thread series of bolts and nuts; threads of special diameters, pitches, and lengths of engagement; fire hose threads; and pipe threads. Standard dimensions and tolerances for a complete line of threading tools and gages as well as for the product, have also been adopted and will be included in the 1924 revision of the Commission's report, which has just been submitted for approval of the Secretaries of War, Navy, and Commerce, and is now ready for the printer.

New Report Will Be Valuable

The 1921 Progress Report was widely accepted in the industries, and it is believed that the 1924 report, which has been rearranged and enlarged, but not changed in any essential features, will be found still more valuable and convenient.

The work of the Plain Gage Committee, with which the Bureau is co-operating, has also made good progress. The Committee has agreed upon a classification of machine fits, including allowances and tolerances for each class, and upon a classification of and specifications for plain limit gages for general engineering work. The report, which has been approved by the Committee, is based upon the manufacturing experience of many prominent engineers and manufacturers of interchangeable parts, and should serve as a very helpful guide in this field.

The Bureau's work on the production of precision screws has been the outgrowth of demands from manufacturers of dividing engines and similar apparatus for screws of high accuracy. The production of screws of this character involves many problems which the commercial manufacturer is not ordinarily in position to solve. Many of the problems involved in cutting, grinding, lapping, and mounting precision screws for use in producing other screws, and for the operation of dividing engines and similar apparatus, have been successfully attacked and their solution has made possible the production of screws of higher accuracy than that previously attained. This work is being continued and it is confidently expected that within a relatively short time, possibly within the next year, the Bureau will be able to meet the most exacting demands of industry and science in this important field.

The Bureau's work in the development of methods for the production of precision gage blocks is more familiar to you, and I need only mention it. By methods developed at the Bureau precision gage blocks of high quality are now produced commercially in the United States, whereas previously they were available only by importation. The advantages of being able to produce them in this country are obvious. There is no longer the danger of the price becoming prohibitive as the result of unusual demands, or of the supply being cut off in time of war.

The laboratories of the Bureau are equipped for carrying out investigations and tests of gages, measuring tools, graduated scales, and other apparatus and measurements, such as coefficients of expansion, of importance to the builders of machine tools and I should welcome the opportunity of placing these facilities at your disposal, and of rendering all possible assistance in the solution of your problems.

Metallurgical Items

Some of the metallurgical items in which the Bureau is co-operating with the machine-tool industries may be illustrated by researches relating to the heat-treatment and performance of high-speed lathe tools and the study of steels for gages. The work on high-speed steels is being carried out jointly with the metallurgical staff of the Washington Navy Yard but has had the active co-operation of steel manufacturers and others. It originally consisted of a critical survey of so-called competitive break-down tests used by large consumers as a basis of purchase of high-speed steels. Subsequently a study was made of the heat-treatment of several important commercial types in this group of steels and at the present time attention is being given to tool performance in rough-turning different carbon and alloy steels first heat-treated in various ways.

So far, important limitations have been developed in both the "breakdown" and "Taylor tests" and much data obtained concerning heat-treatments giving longest tool life under severe service and the prevention and elimination of the undesirable conditions concomitant with "flaky fractures" sometimes developed in the treatment of high-speed steels.

The work with gage steels is being carried out under the direction of a special committee composed of gage makers and users, steel manufacturers and representatives of various government departments; it requires and has the active co-operation of all interests represented and its ultimate purpose is the preparation of specifications covering the composition and heat-treatment of steels better suited for gages than those now most generally used. So far material progress has been made in the study of some of the principal variables to be considered such as wear resistance, control of dimensional changes in hardening and subse-

quent time changes. Wherever possible, laboratory experiments are supplemented by service tests and there are at present in various plants or in preparation for such service tests more than one hundred gages, a complete history of which is available.

As to simplification, the elimination of sizes and varieties which can advantageously be dispensed with, the Division of Simplified Practice has the following program relating to matters of interest to the machine tool industry.

Simplified Practice Committees have been making intensive surveys in four of the following fields, and have rendered occasional reports of progress to us:

1. *Milling Cutters:* Up to date, a simplification program involving a 30 per cent elimination of varieties has been drafted, and a general conference on this subject is imminent.

2. *Taps and Dies:* A survey is in active progress and it is thought by the Simplified Practice Committee that a 32 per cent elimination of varieties may be eventually practicable.

3. *Lock Washer and Nut Lock Manufacturer:* Within the Simplified Practice Committee there is not a unanimity of opinion as to just which eleminations would be practicable, for the reason that this project is interdependent upon standardization in allied fields. However, the Committee concurs in the belief that eventually definite eliminations in diameters and thicknesses will result in cutting off approximately one-third of the present list.

4. *Drills and Reamers:* An eventual elimination at least of 15 per cent is contemplated by the Simplified Practice Committee.

5. *Arbors for Drill Chucks:* There is no trade association through which we can work, and our contacts have had to be made through correspondence with scattered individual firms. Some interest has been manifested, but not sufficient to warrant the institution of concerted action.

6. *Carriage and Machine Bolts:* Recommended, prepared and accepted, but is now in the hands of a special committee for modification, this project being dependent upon wrench-opening standardization.

7. *Expansion Lathe Mandrels:* The Navy Department points out the need for simplification in this field. We are now making a study of the situation.

Considering machine tools as "The Master Tools of Industry" (the slogan for which Dean Kimball of Cornell recently won a $500 prize*) I believe that an increased demand for such tools will arise out of the continuing simplification of commodities. For example, as paving bricks are simplified to a common size, brick-laying machines will be more practicable, and the increasing use of those machines will require more machine tools to make them.

Similarly, simplifying containers, etc., to standard sizes permits mechanical handling and increases demand for conveying, packing, and wrapping machinery, and thus increases demand for machine tools to build these "special purpose" machines.

Also, the restriction of immigration, and consequent shortage of common labor intensifies the need for labor-saving machinery, and the consequent demand for the "master tools" which make them.

I cannot close without further reference to the Federal Specifications Board. When it is recalled that the Federal Government is the largest buyer in the country purchasing some $260,000,000 worth of commodities a year, the importance of a federal policy relating to purchases and unified specifications becomes apparent.

With the installation of the Bureau of the Budget, the President of the United States became for the first time in the history of this country the actual business head of the Federal Government. One of the principal questions before him was the necessity of setting up certain agencies for the co-ordination and control of Government routine business. To promote economy and efficiency in this routine business the President designated a Chief Coordinator, Colonel H. C. Smither, who is charged with the direction and application of uniform business principles and methods, and acts under the general direction of General H. M. Lord, Director of the Bureau of the Budget.

Federal Specifications Board

By direction of the President, there were established several co-ordinating boards relating to certain specific activities of the Government. The Federal Specifications Board is the only one of these boards which is of interest to us for the moment.

Up to the present time, 210 master specifications have been promulgated as official Government standards. Some of these specifications are of particular interest to machine tool manufacturers, for example, lubricants; belting; various paint and varnish materials; soap; fire extinguishers; hose; electrical supplies; bituminous materials; packing and gaskets; metals; and so on.

The Board now has under consideration specifications for abrasives and polishing materials, hack saws, tool steel, and will probably soon take up the consideration of gages. A complete list of the specifications, and instructions for their procurement, can be obtained by addressing the Federal Specifications Board, care of the Bureau of Standards, Washington, D. C.

Great strides have been made in the art of machine tool production in the last generation, and in that production there is a large gap between the inception of the original idea and the consumer; that gap has been filled with the efforts of the inventor, engineer, physicist, chemist, business man and economist.

The Machine Tool Industry

The standardization of machine tool elements and small tools offers a fertile field for great contributions to national prosperity and economy. This general problem has much in common with all other problems of standardization. The elimination of unnecessary sizes would be of primary importance. The standardization of work-holding and tool-holding devices now under way will be of almost equal importance.

The machine tool industry has an effective trade organization known as the National Machine Tool Builders Association headed by R. E. Flanders, who is also one of the most useful members of the National Screw Thread Commission. The many difficult technical problems confronting the industry are well appreciated by Mr. Flanders and his associates; and such exhibitions as we are opening today together with the technical papers to be here presented, the round-table discussions and committee meetings, will undoubtedly be of great stimulus and usefulness to the industry and the community.

*Given by the *American Machinist* in its contest to secure a slogan which will most clearly and forcefully depict the underlying importance of machine tools in creating modern industry and developing civilization.

American Machinist
Established 1877
KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

The Franklin Institute's One Hundredth Birthday

THE centenary celebration of the founding of the Franklin Institute which took place in Philadelphia on Sept. 17, 18 and 19 marked an epoch in the growth of institutions of research and learning in the United States. Starting when the country was young and almost entirely devoted to agriculture, the founders of the Institute had some visions of the industrial growth which was to take place and realized that knowledge of the sciences must not be confined to the few if we were to secure the best results for all concerned. For, in addition to being a forum for the exchange of ideas by men of experience, it has always been a place where the knowledge already gained could be imparted to the younger generation.

Its growth has not been rapid as compared with other institutions, and largely because its light was more or less hidden under the proverbial bushel for many years by the conservatism of its management. This may have been as well from many points of view as it has kept the Institute practically free from commercialism during the century.

The management during the later years has done much to make the scientists of the world realize the high place which the Franklin Institute has won as a center for the dissemination of engineering and scientific knowledge. A glance at the list of scientists who gathered from all parts of the world to celebrate the centenary gives unmistakable proof of the esteem in which the Institute is held in other countries.

To the present management belongs great credit for the manner in which the celebration was planned and carried out. The work of the Franklin Institute deserves to be better known in our own country so that it will receive the financial support it deserves. For those who are unfamiliar with the Institute and its work we shall publish early in October an article by its president, William C. L. Eglin.

Quality as Well as Quantity

ONE reason given for the failure of the company building the Lafayette automobile is that the quality of moderate-priced cars has so improved that the market for the expensive vehicle has been greatly narrowed. There is probably a lot of truth behind this reason. Certainly the quality of the car in the $1,000 to $1,500 class is far ahead of what it was only a few years ago.

The number of buyers who can afford expensive cars is not very large anyway and there is plenty of competition for their patronage. To make matters worse, some of these wealthy people have discovered that the $1,500 car of 1924, in design, in workmanship, in quality of materials used, is ahead of the $3,500 car of ten years ago. There may be an exception in that the body trimmings of the cheaper car are not quite so good, but any part which is the product of machine tools is much better.

These same people have found that the less expensive car will carry them as comfortably, at speeds far outside the law, and far more economically. One reason why they have wealth is because they understand the value of a dollar and spend to get the most for their money. Consequently they are buying cars in the lower price range.

There will always be a class that will demand expensive motor cars to satisfy their desire for ostentation but the manufacturer of that type of car has his work cut out for him to hold his own against the steady improvement of the better sort of quantity-production automobile.

Going Fishing

"IF A certain pompadour-haired gentleman from Wisconsin is successful in November, I am going fishing for four years." So remarked the head of a big industrial corporation. Probably he did not intend his remark to be taken quite literally but it is significant.

This same business man said that his business had been very fair and that plans for two big expansions waited only on the result of the election. If the radical-Socialist group obtained control of the government these plans would continue in abeyance, the men to whom they would mean direct employment would have to look elsewhere for work and the companies and workmen that would benefit indirectly through the expansion of activity would be denied that stimulus.

Here is something for the voter to think about. Economists may insist that a presidential election does not affect the business cycle, and in the long run they are probably right. But when there is so definite a battle drawn between constructive conservatism and destructive radicalism there is likely to be some hesitancy, at least, in making large commitments and investments.

Regulation Needed for Civilian Aviation

SENATOR Wadsworth of New York was quoted a few days ago as saying that legislation for the regulation of civilian aviation is vitally needed. The occasion was the landing of the round-the-world flyers at Boston. The Senator made the trip from his summer home in Maine by airplane and was thus forcibly reminded of handicaps under which flying is done in this country.

Unfortunately Senator Wadsworth is one of the few national legislators that are awake to the seriousness of the situation. If only every member of each house could be treated to a long flight with a forced landing or two, and landed in Canada to be arrested as an outlaw because of not being properly licensed, something might be done to put civilian flying on a sound basis.

The proposal has been made to establish a Bureau of Civil Aviation in the Department of Commerce. An act to inaugurate such a bureau has even passed the Senate. Let us hope that the world flight will arouse Congressional interest sufficiently for both houses to pass such an act in the next session and make it a law.

Shop Equipment News

Besly Crankshaft Lapping Machines

Charles H. Besly & Co., 118 N. Clinton St., Chicago, Ill., is now marketing a couple of lapping machines to be used in polishing the main and connecting-rod bearings of automotive crankshafts. The machine illustrated in Fig. 1 is designed for lapping the main bearings of a four-throw crankshaft, and the one shown in Fig. 2 is used for lapping the connecting-rod bearings on the same part.

The bed of the machine has dovetailed ways upon which are mounted the saddles that carry the wheel-head slides. In Fig. 1 four brackets on the front of the bed support the work table. The work table is 71 in. long and is furnished with a 1⅛-in. T-slot for attaching the driving head, the tailstock and driving mechanism, and the supporting rests.

The driving head is mounted on the left-hand end of the work table and has a driving pulley carried on a friction clutch sleeve. The shipper sleeve has a taper nose that disengages the clutch and engages a stationary friction cup to stop the work spindle, when thrown to the right. The clutch shaft drives the work spindle through a pair of helical gears. The spindle is provided with faceplate to which various work drivers may be attached and also has a center for carrying the work. A ball-thrust bearing is fitted to the spindle and the journal bearings are phosphor-bronze.

The tailstock is of the quick-acting type, actuated by a compression spring and a cam lever movement that can be operated by either hand or foot. The work rest is provided with two hard-wood blocks that can be adjusted to accommodate any size crank.

The saddles carrying the wheels can be moved to the desired position on the bed by means of screws. The wheel-head slides are mounted on long guides on the saddles and can be moved to and from the work by means of rack and pinion movements at the front of the machine. Stop screws are located in the table casting for regulating the pressure of the wheels against the work.

The wheel spindles are mounted in ball bearings in dust-proof housings and the driving pulleys are shrunk on the spindles. The two outer spindles are made with taper noses, to which the spiders of the 24-in. hard felt wheels are attached. The center head spindle has the wheel spider attached directly to a flange on the driving pulley as this head is limited for space and it is necessary to run the wheel between the bearing housings. Hoods are provided for all wheels.

The wheels are of suitable width to cover all bearings being lapped so that no endwise movement of the wheels is necessary, except in special cases. The wheel spindle speed is 1,150 r.p.m., the work spindle running at 320 r.p.m. Powdered glass or other powdered abrasives may be used, as desired.

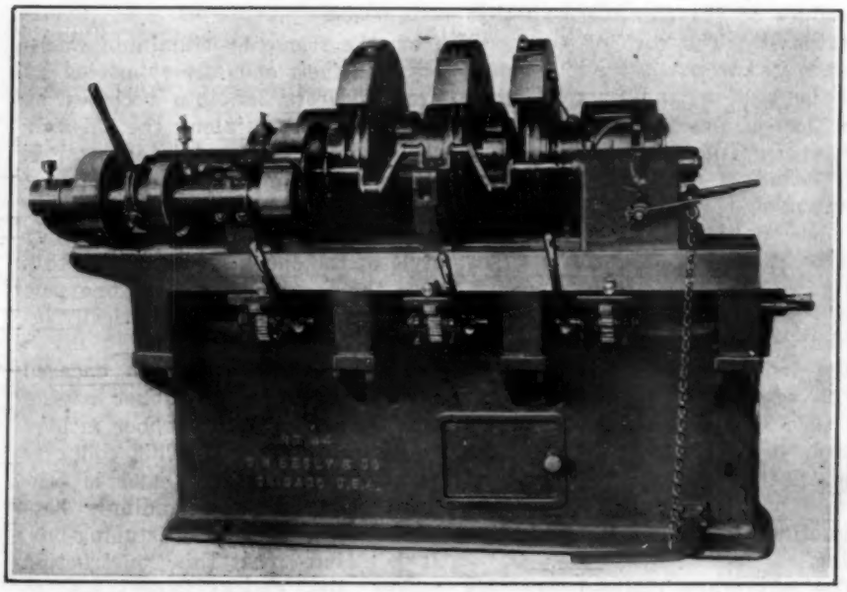


Fig. 1—Besly Three-Head Crankshaft Lapping Machine

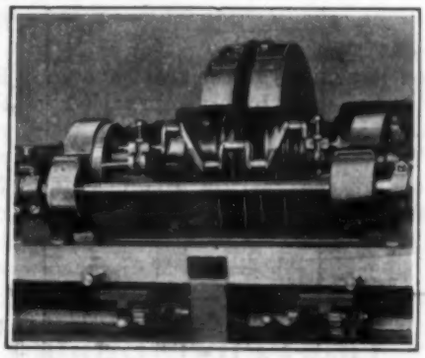


Fig. 2—Wheels and work-table of two-head lapping machine

The machine for lapping the throw bearings, shown in Fig. 2, is the same as the other in general design, with the exception of the work-carrying mechanism and the number of wheels. The work-holding mechanism is composed of two separate units attached to the ends of the table. The friction clutch device is the same as on the other machine, but the clutch shaft extends the length of the table, driving each unit through helical gears. The crank-carrying fixtures are special and are built to suit the work to be done.

A rear view of the machine is given in Fig. 3 and shows the method of arranging the machines for motor drive. The motor is mounted inside the machine base at one end and transmits its power through a silent chain drive enclosed in a sheet-metal

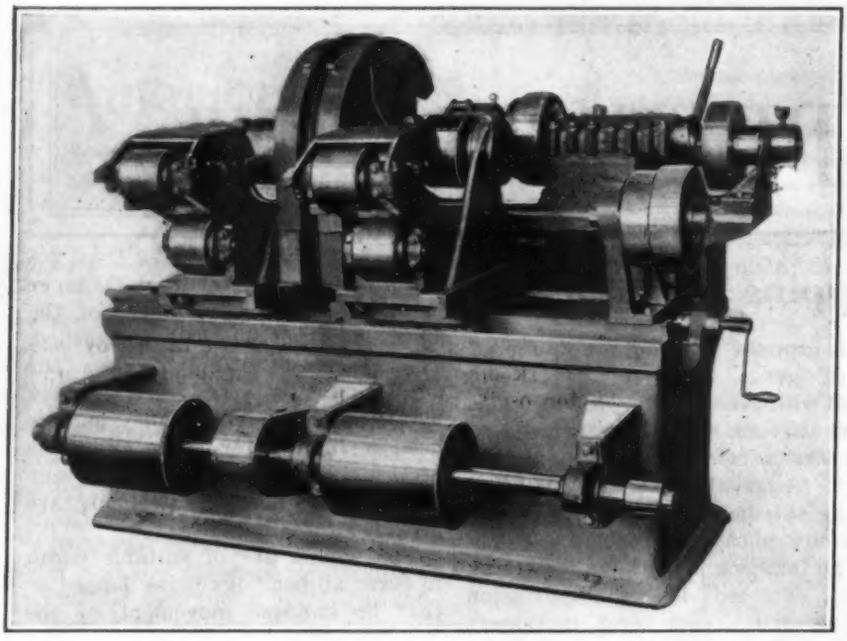


Fig. 3—Rear view of Besly two-head lapping machine

case. Openings in the front and end of the machine base are provided to give access to the motor.

The silent chain drives the jackshaft at the rear of the machine, this shaft being furnished with pulleys to accommodate the belts for driving the wheel and work heads. Ball-bearing pillow blocks support the jackshaft. A 7½-hp. motor is required to drive the two-head machine and a 10-hp. motor is necessary for the three-head machine. The recommended speed for the motors is 1,740 r.p.m. Belt-driven machines are furnished with countershafts.

Taft-Peirce Bipolar Magnetic Chuck

The Taft-Peirce Co., Woonsocket, R. I., has brought out under the Simmons patents a type of magnetic chuck that possesses some novel features of construction. As in all Simmons chucks the magnets are insulated from the shell or casing of the chuck, so that the latter is not a part of the magnetic circuit.

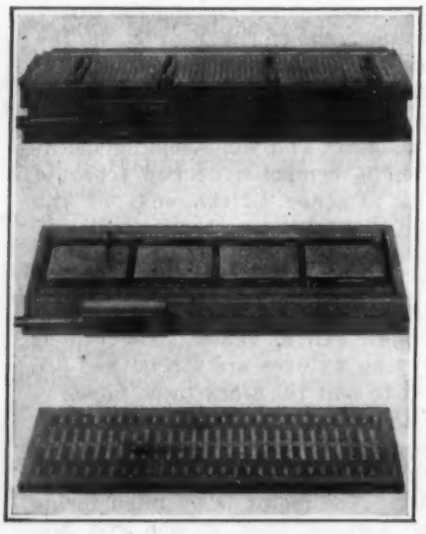


Fig. 1—Taft-Peirce Bipolar Magnetic Chuck

The body of the magnetic unit has a channel section, as shown in the middle view of Fig. 1. The open side of the channel is uppermost and the edges are flush with the edges of the chuck casing that contains it. The core of each coil is made in two parts, the lower part oval in section and cast integral with the channel, and the upper part, ending in a rectangular shaped pad, attached to it by machine screws after the coil has been placed in position. In Fig. 1 there are four coils, separate from each other and from the casing of the chuck, being magnetically insulated from the latter by brass spacers and held in the casing by brass screws.

The edges of the channel form one pole and the rectangular pads of the central cores the opposite pole of the magnet. All exposed surfaces are ground flat after the magnetic unit is assembled in the casing.

The advantage claimed for this construction is that the exposed pole-faces, which constitute the working face of the chuck, may be of any shape or size, or disposed in any position that may be suited to the nature of the work-pieces to be held. It is only necessary to so shape the underfaces of the pole-pieces composing the top plate that alternate pieces will bear upon opposite poles of the magnets beneath.

The lower view of Fig. 1 shows the underside of the top plate shown in position on the chuck in the upper view. It will be observed that one-half of the pole-pieces have a rectangular foot at each end to bear upon the edges of the channel, the intervening pole-pieces being cut away at the ends and bearing only upon the rectangular pads at the center.

The alternate pole-pieces are assembled upon long brass screws that pass through each pole-piece and the ends of the rectangular frame of the top plate. The pole-pieces are separated from each other and from the frame by aluminum washers, and their ends are supported by brass bearers let into recesses at suitable intervals along the sides of the frame. Molten white metal is poured into the spaces that surround the pole-pieces and fills the gaps between them. In Fig. 2, the rotary style of the chuck is shown. In this case the frame constitutes one pole of the magnet and is magnetically insulated from the casing.

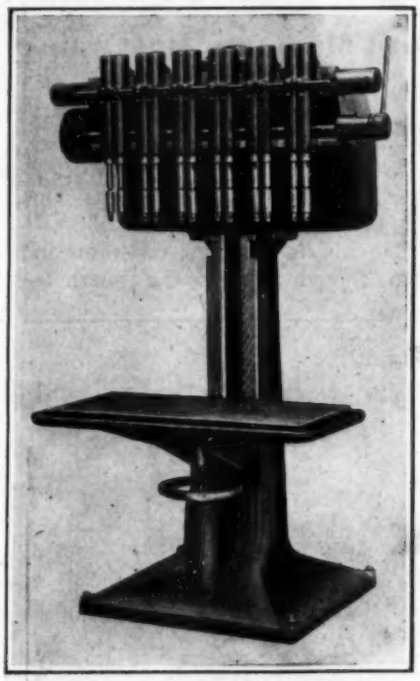
Fig. 2—Top plate of rotary chuck

The conducting cord is encased in a flexible tube of rubber having an enlarged collar of rubber molded on it near one end. This collar is bevelled on both faces and is confined between correspondingly bevelled brass faces of a stuffing-box. It is claimed that this construction makes the chuck impervious to water.

Defiance No. 51 Valve Grinding Machine

A recently developed product of the Defiance Machine Works, Defiance, Ohio, is the No. 51 valve grinding machine shown in the accompanying illustration. This machine is furnished with twelve or sixteen spindles and is adapted for use by manufacturers of gasoline engines in the grinding of all the valves in a cylinder block at one operation. A smaller size machine, No. 50, is built with two, four, six or eight spindles.

In operating the machine the operator has only to hold the valve head drivers down against a regulated spring tension by pressing lightly against a lever. Provision for doing this automatically may be made in the design of the work holding fixture. The oscillating motion of the spindles, together with the lifting and returning of the drivers, is automatic.



Defiance No. 51 Valve Grinding Machine

The oscillating movement of the spindles is obtained through spur gears and a sliding rod that effects an easy reciprocating motion of the drive rack without vibration or excessive lateral thrust. The spindles oscillate through 1¼ rev., and the vertical movement of the spindles occurs every ten revolutions.

The table for holding the work is gibbed to the base of the machine and is provided with a binding screw. It is adjustable on its guides vertically by means of a screw operated by a handwheel. The spindles are ground and fitted in sleeves where they run on ball bearings at both ends. The spindle heads are gibbed to the top frame and have screw adjustments by which each head may be adjusted independently. A lever is provided to bring the spindles down against the drivers and valve heads.

Fixtures for holding the work on the table and the drivers for oscillating the valve heads are special equipment, but can be furnished as required. The drivers are made with suitable tension to bear on the valve heads with the proper pressure, and the driving points are designed to suit the valve heads.

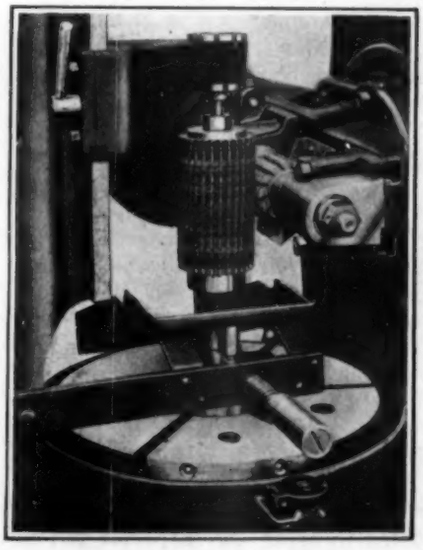
The minimum distance between centers of the spindles is 1⅛ in. and the maximum distance between outside spindles is 30 in. The spindles are located 7 in. from the face of the upright. The working surface of the table is 15 x 32 in. and the vertical adjustment of the table is 12 in. From the nose of the spindles to the table the distance is 25¾ inches.

The machine can be driven by belt or motor. The standard machine with twelve or sixteen spindles requires a 5-hp. motor running at about 1,100 r.p.m. The net weight of the 12-spindle machine is 1,350 lb., the 16-spindle machine weighing 1,450 pounds.

Gould & Eberhardt Quick-Loading Mandrel for Fiber Gears

Inasmuch as the removal of finished fiber gears from a gear cutter and the loading of blanks usually requires more time than the actual cutting of the teeth, Gould & Eberhardt, Newark, N. J., have recently developed a quickly removable mandrel for use on their gear hobbing machines.

In connection with the mechanism for removing the mandrel quickly from the machine, two mandrels are used so that the operator can be unloading and reloading one while the cutting is being done on the blanks held by the other in the machine. The mandrel or arbor is held at the top by the work support bushing, as shown in the accompanying illustration, the lower end being seated on a taper stud carried by a flange bolted to the machine table.



Gould & Eberhardt Mandrel for Fiber Gears

To release the mandrel, the handle near the lower end is given a sharp blow with the hand. A ring, which serves as a wedge under a shoulder on the arbor, is raised by the movement of the handle, thus releasing the mandrel from the spindle. The work support is then raised, the mandrel is removed, and the loaded mandrel is seated on the taper stud. The machine is then ready to start, after the work support is lowered.

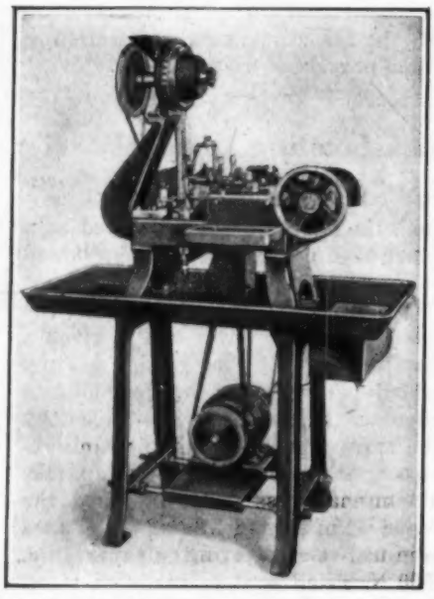
The device is, of course, adapted for the cutting of small gears from any material. In the illustration the machine shown is engaged in cutting the teeth on fiber speedometer gears. Twenty-five gears are mounted on each mandrel and the machining time for these gears from floor to floor is 3 minutes, of which 2.3 min. are cutting time and 0.7 min. the time for loading and unloading the machine.

An inclined chip protector is located at the bottom of the mandrel and serves to keep the releasing mechanism clean by deflecting the chips to a box on the floor. It is stated that the gears made on this mandrel have the same accuracy as those cut on the non-removable type of work arbor. For gears with center holes of different diameter it is only necessary to provide a straight mandrel of the proper diameter, with bearing and threads on one end and a taper hole to fit the work table stud on the other.

Waterbury Farrel Automatic Rivet Drilling Machine

The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., has recently placed on the market an automatic machine for drilling out the centers of hollow rivets. Such rivets are made on a solid die header and have a countersink in the end of the shank to facilitate the centering of the drill point.

The blanks are fed automatically from a drum hopper into a vertical slide at the bottom of which they



Waterbury Farrel Automatic Rivet Drilling Machine

are transferred to a device that carries them to the drill. After drilling they are transferred to an inspection mechanism and are then automatically ejected into a receptacle. The machine is usually motor-driven but can be arranged for belt drive. The motor is located at the rear of the machine and the drill spindle is driven by a belt from a pulley on one end of the motor shaft. The remainder of the moving parts of the machine are driven from a multiple pulley at the other end of the motor shaft. The back-shaft of the machine is driven through a worm reduction gear and a jaw clutch.

The drum hopper is rotated continuously by a belt from the back-shaft and picks up the rivet blanks in radial notches in its periphery. From the hopper the chute receives the blanks and delivers them to the transfer blade below. The transfer blade is of sheet steel and is mounted on a transfer slide that is moved by a barrel cam on the back-shaft. The slide is moved out positively and its return movement is actuated by a spring, an adjustable stop being provided to locate the blank in line with the drill spindle.

The transfer blade has three notches for holding the blanks and, as soon as a blank falls into the first notch, it is transferred to the drilling position. The blank is lifted out of the notch and gripped during the drilling and the transfer blade returns for the next blank. The second blank also enters the first notch in the blade and before the transfer stroke the first blank, with the hole drilled, enters the second notch. By the transfer stroke the drilled rivet is taken to the inspecting mechanism and the second blank is presented for drilling.

The blade then returns and the third blank enters the first notch, the second blank is drilled and passes into the second notch, and the first blank after inspection goes into the third notch. The transfer stroke of the blade then delivers a blank to the drill, the drilled rivet to the inspection device, and the finished rivet to the ejector. This sequence continues during the operation of the machine.

The gripping device for holding the rivets for drilling and inspection incorporates a slide that is moved vertically by a cam on the back-shaft. The slide has a jaw that holds the blank rigidly against a stationary upper jaw at the drilling position, and a similar jaw holds the drilled blank at the inspection station.

The drill spindle is mounted in ball thrust bearings in a slide that is fed forward by a cam on a shaft at the end of the machine. The spindle carries a standard No. 1 Jacobs drill chuck, and can be adjusted longitudinally on the slide. To change from one depth of hole to another the cam must be changed. One cam is furnished with the machine and a set of six cams will give a variation in depth of hole from $\frac{1}{8}$ to $\frac{1}{2}$ in. in $\frac{1}{16}$ in. increments.

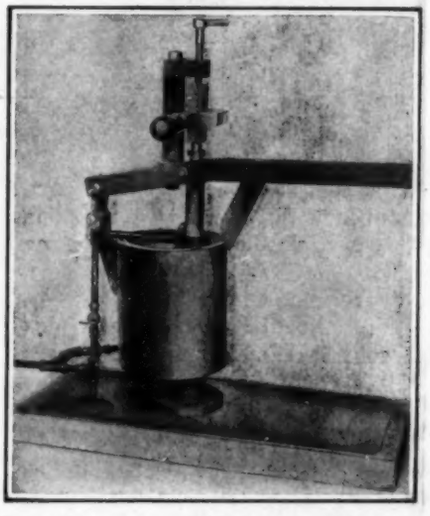
The inspector slide moves forward with the drill slide, and can be adjusted to bring the inspector pin in the head on the slide as far forward as possible without bottoming in the hole. In the event that the drill has broken off in the hole, the inspector pin will strike against it, causing a fulcrum lever in the head to trip and release the main clutch. This device functions also if the hole is drilled shallow for any reason. The inspector slide is also adjusted to relocate the pin with respect to the drill as changes occur due to grinding.

The maximum size of rivet that the standard machine will handle is $\frac{7}{16}$ in. in diameter and $\frac{3}{4}$ in. long. The speed of the machine can be changed to suit different materials. The speeds of the camshaft range from 17 to 61 r.p.m. The floor space required is 25¾x44 in. and the net weight of the machine is 600 pounds.

Byrd Miniature Die-Casting Machine

A hand-operated machine for making small die castings has recently been placed on the market by R. E. Byrd, 318 Reed St., Erie, Pa. One die is furnished with the machine.

The die is clamped together and then forced against the nozzle of



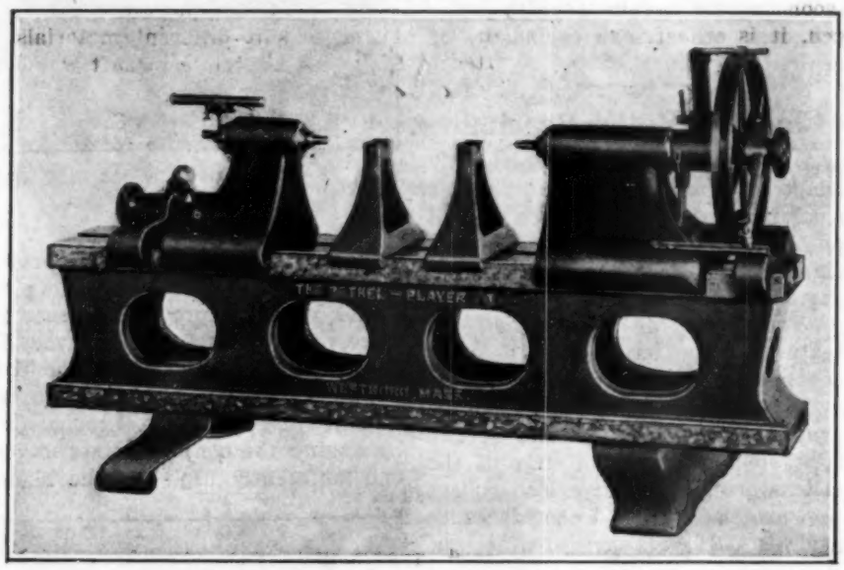
Byrd Miniature Die-Casting Machine

the machine by a screw at the top. The top of the nozzle is hemispherical and fits into a suitable seat in the die. When the die is in position the operator depresses the lever, forcing the molten metal up through a hole in the center of the nozzle and into the die. The lever is depressed until the die is full and is then raised to the position shown in the illustration, the die then being removed and the casting ejected.

The metal melting pot is 6 in. in diameter and will hold 15 lb. of metal. The machine is arranged to be screwed to the bench and its over-all length is 22 inches.

Bethel-Player Measuring Machine and Comparator

The Bethel-Player Co., Westboro, Mass., has recently developed and now has ready for the market a precision measuring machine by means of which variations in dimensions of 0.00001 in. can be detected. The device embodies a tilting level mounted upon the end of an amplifying arm in such a manner that a displacement of the measuring anvil through 0.0002 in. causes a 1-in. movement of the bubble. The machine does not render arbitrary measurements, but determines the amount of variation between a piece of work and a standard gage block or measuring rod.



Bethel-Player Measuring Machine

The measuring spindle is made in two parts joined together by a floating coupling so that the screw may be turned without rotating the exposed end. To reduce the friction between the rotating and non-rotating members a standard steel ball is interposed. The shell of the coupling contains a coil spring that holds the two members in contact with the ball and serves to eliminate backlash. Both parts of the spindle, including the 20-pitch, V-thread measuring screws, are hardened, ground and lapped. The measuring dial is a cast-bronze wheel 8 in. in diameter, and is fitted with a steel vernier scale. There are 500 divisions on the wheel.

The arm that holds the vernier is adjustable about the axis of the wheel, and a knurled knob on the end of the spindle is provided for rotating it to obtain approximate settings. An aluminum arm with an adjusting screw at its outer end is carried on the hub of the wheel and may be clamped to it when extremely accurate settings are to be made. The error of the measuring screw is compensated by a device in the head that moves the zero of the vernier in accordance with the error.

The rear anvil rests against an amplifying lever that carries at its upper end an enclosed level with a graduated glass. This lever swings about a pivot and is caused to rotate as the anvil is moved by the pressure of the work upon it, thus tilting the level. A steel ball is interposed between the rear end of the anvil and the lever and the mechanism is held in its forward position by the tension of a spring.

To test a piece of work for diameter or length a standard gage-block or measuring rod of the required dimension is placed between the measuring spindle and anvil and the head and foot stocks are adjusted along the bed and clamped in position. The measuring spindle is rotated by means of the knurled knob until the spindle and anvil are in contact with the gage, after which the aluminum arm is clamped to the hub of the wheel for the final setting.

When the adjusting screw at the end of the arm is turned the spindle advances and pushes back the anvil until the level is tilted sufficiently to bring the bubble from the rear end of the glass to the zero line in the middle. The vernier arm is then adjusted to bring the zero line of the vernier into coincidence with the zero line of the dial. The work is then substituted for the gage or rod and the bubble is again brought to the zero line at the middle. If there is any variation between the piece and the standard, it is shown by the difference of the vernier readings.

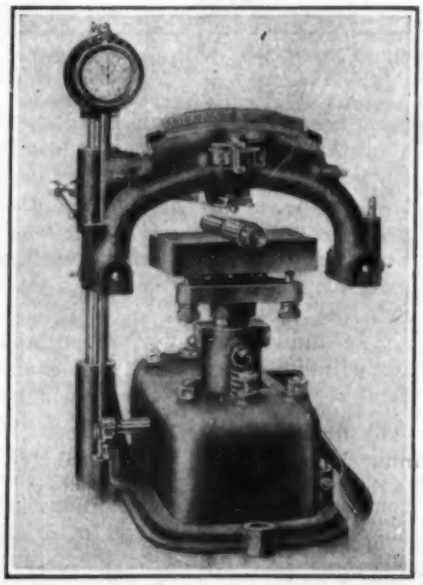
The base of the machine is of box section and is well ventilated to minimize the possibility of distortion through temperature changes. It is supported so that the machine has a three-point bearing. It is recommended that it be installed on a substantial concrete foundation.

The machine measures any length from zero to 12 in., and to the center of a 9-in. circle. The bed is 4½ in. wide by 33 in. long and 7 in. deep. The machine is provided with a pair of V-blocks as shown in the illustration. Its weight, fully equipped, is 140 pounds.

Herbert Pendulum Operating Stand

Edward G. Herbert, Ltd., Manchester, England, has recently brought out an operating stand for use with the Herbert standard pendulum hardness tester. The device is being marketed in America by the Tinius Olsen Testing Machine Co., 500 N. Twelfth St., Philadelphia, Pa., and is shown in the accompanying illustration.

This stand is especially adapted for inspection testing in which a large number of tests must be made



Herbert Pendulum Operating Stand

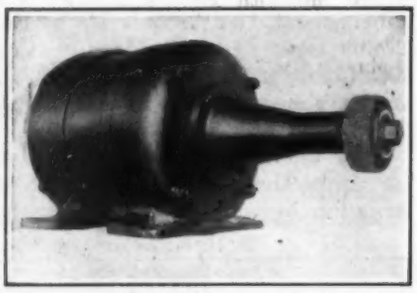
rapidly, and also enables the making of "time tests" without previous practice. The pendulum hardness tester and its operation was described on page 817, Vol. 58, of the *American Machinist.*

The device is operated by means of a single handle. First the table is released and allowed to rise until the pendulum swings gently on the work. The stop watch is operated by a slight movement of the same handle and, at the end of the test, the table is lowered and the pendulum is replaced on its three-point support. The arm supporting the pendulum can be raised to admit specimens up to 6 in. thick.

A ball-pointed diamond can be supplied for the inspection of very hard steels. The table is mounted on a plate that rests on three levelling screws, and can be replaced by special fixtures for irregular work.

Forbes & Myers High-Speed Grinders

To give proper operating speeds for wheels from 2 to 4½ in. in diameter and to maintain these speeds under load, Forbes & Myers, 172 Union St., Worcester, Mass., have recently added two models, Nos. 9 and 10, to their line of grinding



Forbes & Myers High-Speed Grinder

machines. The usual method of obtaining the necessary speeds with 60-cycle alternating current has been to use the series motor, but this motor slows down too much when the load is applied and requires more care than is generally given a grinding motor.

The induction motor is suitable for grinding work because it maintains its speed under any reasonable load and is simple in construction and operation. For driving these recently developed grinders this company has built true induction motors to run at speeds of 5,400 and 7,200 r.p.m. on 60-cycle current, and at 2,250 and 3,000 r.p.m. on 25-cycle current. The higher speeds are right for wheels 3 and 4½ in. in diameter, and the speed of 7,200 r.p.m. is suitable for wheels down to 2 in. in diameter, or even smaller.

The wheel on the grinders are spaced 7 in. from the motor in order to avoid interference, the spindle being supported next to the wheel by a hollow arm. The spindle is ½ in. in. diameter at the wheel. A ¾-hp. motor furnishes all the power that can be used to advantage with the small wheels.

The motor can be furnished for purposes other than grinding, if desired.

Chandler Roller Bearings

A line of roller bearings especially adapted for use in line and counter shafting, has reecntly been placed on the market by the Chandler Machine Co., Ayer, Mass. The essential parts of the bearing are shown in the accompanying illustration. A feature of the bearing is the split construction.

A series of rollers are spaced around the shaft by means of two split steel rings. The ends of the rollers project into two load collars that are also split and provided with grooves at the center into which the spacing rings fit loosely. The halves of the load collars are held together by screws. Trunnions on the load collars locate them in the housing of the bearing and permit them to adjust themselves to the alignment of the shaft.

The bottom section of the housing serves as an oil cellar and is fitted

Chandler Roller Bearings

with copper oil retainers at either end. It is said that when the bearing is running the exposed sections of the rollers between the load collars carry the oil around the shaft and assist in proper lubrication of the parts. The housing is designed to fit both the plunger hanger and the four-point hanger. A series of twelve sizes is available for shafts from ⅛ to 4 in. in diameter.

Taft-Peirce Demagnetizing Switch

The Taft-Peirce Co., Woonsocket, R. I., is furnishing with its magnetic chucks a type of demagnatizing switch that automatically de-

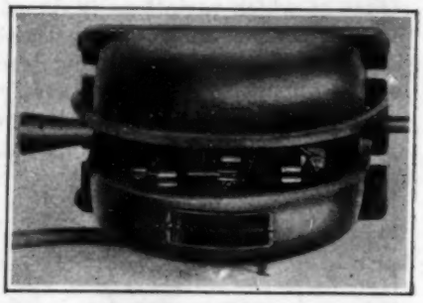


Fig. 1—Taft-Peirce Demagnetizing Switch

magnetizes the chuck when thrown to the off position. It is shown in Fig. 1 with the protecting cover in place, and without the cover in Fig. 2 to display the construction.

This switch differs from the usual type of two-pole, double-throw switch by having the contact points at one end sufficiently high for the blades

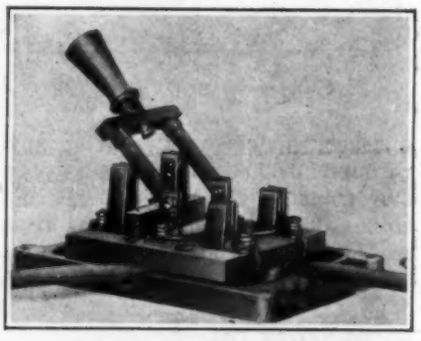


Fig. 2—Taft-Peirce switch with cover removed

to pass between and beyond them, and be out of contact when the lever reaches its final position. These contacts are so connected that they cause a reversal of the current. The act of throwing over the lever breaks the circuit as the blades leave the low contacts at one end, and reestablishes it momentarily in the opposite direction as they pass between the high contacts at the other end.

This instantaneous reverse current serves to neutralize any residual magnetism that may remain in the chuck, but is not of sufficient duration to build up magnetism of opposite polarity. Therefore, the work may be removed from the face of the chuck without difficulty.

News of the Week

Record Attendance at Annual Exhibit of Machine Tools at New Haven

Many exhibits and interesting program at Mason Laboratory

The fourth annual exhibition of machine tools to be held under the joint auspices of the New Haven Section of the American Society of Mechanical Engineers, the New Haven Chamber of Commerce, and Yale University, occupied Mason Laboratory on Hillhouse Ave., New Haven, Conn., on Monday, Tuesday, Wednesday and Thursday, Sept. 15, 16, 17 and 18.

The scope of the exhibition has been somewhat extended over that of the previous years and besides including most of the more prominent machinery manufacturers of New England, many from outside that territory were represented. The exhibits were of very diversified character, ranging from the heavier classes of machine tools to the most minute component of their construction. The character of the exhibits indicated less tendency toward specialized machinery than was noticeable last year and more along the lines of improvement and simplification of existing models, increased range, versatility, and added power. The trend toward accuracy of workmanship and reduction of tolerances was evidenced by the display of machines and devices for taking precise measurements. Nowhere was this tendency more pronounced than in the production of screw threads.

Plain bearings are being gradually displaced by ball bearings. Spindles—especially of high-speed grinding machines—that but a short time ago few designers would have had the temerity to mount upon ball bearings are now so mounted, with the result that heavier cuts are taken at higher speeds with no sacrifice of accuracy and practically without variation in worksizes.

High-Speed Steels

Another field in which marked progress has been made is that of cutting tools. High-speed steels are used almost to the exclusion of carbon steels, whether the tools are of the comparatively simple shapes used on lathe and planer, or the more complicated and expensive cutters for milling machine or gear hobber. Where practical, tips of high-speed steel or stellite are welded or mechanically affixed to shanks of less costly metal. In most cases, however, high-speed drills, cutters and hobs are made entirely of that material.

The grinding of screw threads after hardening has become established practice wherever accuracy of pitch and contour are required. Leadscrews, hobs and pieces of a similar character are thus produced and the variation of dimensions are imperceptable.

The attendance was quite satisfactory to the various committees having the exhibition in charge, being appreciably larger than that recorded in previous years. That the majority of the visitors were deeply interested in the capabilities of the machines and tools displayed was amply attested by the fact that the demonstrators were kept constantly busy answering questions as to how this or that machine or tool could be applied to the solution of individual problems, many of which were presented in the form of blueprints and models.

The technical side of the exhibition provided many lectures and talks by men whose names stand high in the machine tool industry. The series of meetings held in Mason and Dunham Laboratories were opened on Monday night by H. L. Seward, chairman of the exhibit and the welcoming address was delivered by Dean Henry G. Graves of the Yale School of Forestry. Dr. George K. Burgess, director of the Bureau of Standards, delivered an address on the relation of the Government to the machine tool industry. An abstract of this speech appears on page 513 of this issue of the *American Machinist*.

Thursday Session

Major Earle Buckingham, Hartford, presided on Tuesday afternoon in the absence of J. A. Smith, of the General Electric Co., of Schenectady. The subject under discussion was "Research Work in Machine Shop Practice." Prof. C. A. Beckett, New York, gave a brief résumé of the progress made in other countries in this direction and the discussion was continued by Wilfred Lewis, Philadelphia, and B. H. Blood, Hartford. E. F. DuBrul, general manager of the National Machine Tool Builders' Association, concluded the meeting by a talk on the subject, "Forecasting Demand for Machine Tools."

The speakers for Wednesday afternoon and evening and their subjects were as follows: "Comparative Methods of Tool Design and the Relation to Quantity Production of Sheet Metal Parts," D. M. Chasen, Elizabethport, N. J.; "Application of Ball Bearings to Machine Tool," H. Reynolds, New Britain, Conn.; "Shop Measurements," Earle Buckingham, Hartford, Conn.

On Thursday, E. C. Peck, Cleveland, spoke on, "Selling Standards to Manufacturing Organizations"; L. D. Burlingame, Providence, R. I., spoke on, "Standardization vs. Individuality"; George T. Trundle Jr., Cleveland, spoke on, "The Value of Standardization with Examples of Accomplishment"; and J. A. Pederson, the Springfield Armory, spoke on, "Manufacturing Design of Ordnance Material."

A very attractive feature of the exhibition was the factory tours and visits to points of interest in and near New Haven, the guests being transported in motor buses to and from the objective points. Industrial motion pictures were shown in the lecture room of Mason Laboratory on Wednesday and Thursday evening.

An interested visitor at the show was Dr. Ing. George T. Schlesinger, Professor of Mechanical Engineering at the Technical High School of Charlottenburg, Germany, and head of the testing laboratory which is supported by the German machine tool industry.

The Exhibitors

The following concerns had booths at the exhibition:

Abrasive Machine Tool Co., East Providence, R. I.; American Crusher & Machinery Corp., 1 Madison Ave., New York City; *American Machinist*, 10th Ave. at 36th St., New York City; American Swiss File & Tool Co., Elizabeth, N. J.; B. C. Ames Co., Waltham, Mass.; Atlas Steel Corp., Dunkirk, N. Y.; Avey Drilling Machine Co., Cincinnati, Ohio; Baker Brothers, Toledo, Ohio; W. F. & J. Barnes, Rockford, Ill.; John Bath & Co., Worcester, Mass.; Bausch & Lomb Optical Co., Rochester, N. Y.; Bay State Belting Co., Boston, Mass.; Boye & Emmes Machine Tool Co., Cincinnati, Ohio; Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.; Brown & Sharpe Manufacturing Co., Providence, R. I.; Bryant Chucking Grinder Co., Springfield, Vt.; Andrew C. Campbell, Inc., Bridgeport, Conn.; Carborundum Co., Niagara Falls, N. Y.; Cincinnati Grinder Co., Cincinnati, Ohio; Cincinnati Milling Machine Co., Cincinnati, Ohio; Jas. Clark, Jr., Electric Co., Louisville, Ky.; Cochrane-Bly Co., Rochester, N. Y.; Diamond Machine Co., Providence, R. I.; R. & J. Dick Co., Inc., 145 Lafayette St., New York City; Eastern Machine Screw Corp., New Haven, Conn.; Electric Hose & Rubber Co., Wilmington, Del.; Fafnir Bearing Co., New Britain, Conn.; Fairbanks, Morse & Co., New York City; Garvin Machine Co., 139 Varick St., New York City; General Electric Co., 129 Church St., New Haven, Conn.; Geometric Tool Co., New Haven, Conn.; Gisholt Machine Co., Madison, Wis.; Goddard & Goddard, Detroit, Mich.; Goss & DeLeeuw Machine Co., New Britain, Conn.; Gould & Eberhardt, Irvington, N. J.; Grant Manufacturing & Machine Co., Bridge-

port, Conn.; Hanson-Whitney Machine Co., Hartford, Conn.; Hart & Hegeman Manufacturing Co., Hartford, Conn.; Heald Machine Co., Worcester, Mass.; Heppenstall Forge Co., Bridgeport, Conn.; G. M. Hessdoerfer & Co., Bourse Building, Philadelphia, Pa.; Heston & Anderson, Fairfield, Iowa; Hoggson & Pettis Manufacturing Co., New Haven, Conn.; Hunter & Havens, Bridgeport, Conn.; Ideal Machinery Co., Plainville, Conn.; Jacobs Manufacturing Co., Hartford, Conn.; H. W. Johns-Manville Co., New York City; Jones & Lamson Machine Co., Springfield, Vt.; Keller Mechanical Engineering Corp., Brooklyn, N. Y.; Kingsbury Manufacturing Co., Keene, N. H.; W. B. Knight Machinery Co., St. Louis, Mo.; Landis Tool Co., Waynesboro, Pa.; LaPorte Machine & Tool Co., LaPorte, Ind.; Leland-Gifford Co., Worcester, Mass.; Lewis-Shepard Co., Boston, Mass.; Lodge & Shipley Machine Co., Cincinnati, Ohio; J. L. Lucas & Son, Inc., Bridgeport, Conn.; Machinery Dealers, Inc., New Haven, Conn.; Manning Abrasive Co., Troy, N. Y.; Manning, Maxwell & Moore, Inc., New York City; C. S. Mersick & Co., New Haven, Conn.; Monarch Machine Tool Co., Sidney, Ohio; Morse Twist Drill Co., New Bedford, Mass.; National Acme Co., Windsor, Vt.; National Machinery Co., Tiffin, Ohio; New Britain Machine Co., New Britain, Conn.; New Departure Manufacturing Co., Bristol, Conn.; New Haven Gas Light Co., New Haven, Conn.; New York Belting & Packing Co., 91 Chambers St., New York City; J. M. Ney Co., Hartford, Conn.; Niles-Bement-Pond Co., 111 Broadway, New York City; Noble & Westbrook, Hartford, Conn.; Norma-Hoffman Bearings Corp., Long Island City, N. Y.; Norton Co., Worcester, Mass.; O. K. Tool Co., Shelton, Conn.; Ohio Machine Tool Co., Kenton, Ohio; Oxweld Acetylene Co., Long Island City, N. Y.;

Page, Steele & Flagg Co., New Haven, Conn.; Peerless Machine Co., Racine, Wis.; Peerless Surfacing Machine Co., Troy, N. Y.; Pratt & Whitney Co., Hartford, Conn.; Henry Prentiss & Co., Hartford, Conn.; Purinton & Smith, Hartford, Conn.; Rhodes Manufacturing Co., Hartford, Conn.; Rivett Lathe & Grinder Corp., Brighton District of Boston, Mass.; Rockford Milling Machine Co., Rockford, Ill.; Rockford Tool Co., Rockford, Ill.; Sidney Machine Tool Co., Sidney, Ohio; Sipp Machine Co., Paterson, N. J.; S. K. F. Industries, 165 Broadway, New York City; Springfield Machine Tool Co., Springfield, Ohio; Standard Steel & Bearings, Inc., Plainville, Conn.; Taft-Pierce Co., Woonsocket, R. I.; Taylor & Fenn Co., Hartford, Conn.; Thomas Spacing Machine Co., Pittsburg, Pa.; H. G. Thompson & Son, Co., New Haven, Conn.; Torchweld Equipment Co., Chicago, Ill.; Torrington Co., Torrington, Conn.; Union Twist Drill Co., Athol, Mass.; Universal Boring Machine Co., Hudson, Mass.; V. & O. Press Co., Hudson, N. Y.; Van Norman Machine Tool Co.; Vitrified Wheel Co.; Warner & Swasey; Waterberry Farrel Foundry & Machine Co.; Westinghouse Electric & Manufacturing Co.; Wisconsin Electric Co.; Wyoming Shovel Co.; and Yale & Towne Manufacturing Co.

Motor Transport Problems Discussed at New York S. A. E. Meeting

Bus operation and maintenance are subjects of debate

Two days were devoted to the problems of automotive transportation at a meeting held in New York City by the Society of Automotive Engineers on Sept. 18 and 19. This was the second automotive transportation meeting and five sessions were held at which many interesting speakers from this country and London were heard. In addition to these sessions a most interesting tour of inspection of motor transport stations was made.

The meeting opened at the Hotel Pennsylvania with a motorbus session at which V. E. Keenen, superintendent of the bus division of the United Electric Railways Co., Providence, R. I.; J. B. Stewart, Jr., general superintendent of the Youngstown Municipal Railway, Youngstown, Ohio; and A. F. Masury, chief engineer of Mack Trucks, Inc., New York City, were the speakers. This was followed by a motorbus luncheon and in the afternoon Hugh G. Bersie, engineer with the Haskelite Manufacturing Co., Chicago, and R. E. Fielder, chief engineer, the Fifth Avenue Coach Co., New York, were the speakers. A paper prepared by F. D. Howell, vice-president of the Motor Transit Co., Los Angeles, Calif., was read.

In the evening a meeting of the Metropolitan Section of the S.A.E. was held at the Hotel Cumberland and Francis W. Davis, consulting engineer, Waltham, Mass., was the speaker.

Second Day's Program

The second day of the meeting was devoted to the problems confronting the motor transport men. Following the inspection of motor transport stations of the Motor Haulage Co., the fleet quarters of R. H. Macy & Co., and the maintenance shops of the Fifth Avenue Coach Co., and a luncheon at the Hotel Pennsylvania, an interesting motor transport session was held. J. A. Hoffman, vice-president of the Motor Haulage Co., New York; H. W. Howard, transport engineer of the General Motors Truck Co., Pontiac, Mich., were the speakers at this session. A paper prepared by J. W. Cain, manager of purchases of the American Short Line Railroad Association, Chicago, was read.

In the evening the closing session was held at the Engineers Societies Building when James Paterson, managing director of Carter-Paterson, Ltd., London, and W. L. Bean, mechanical engineer of the New York, New Haven & Hartford R.R., New Haven, Conn., spoke.

It was agreed by the speakers that the problem of maintenance was regulated by the selection of the type of bus. One speaker pointed out that the annual cost of maintenance on rebuilt buses was 60 per cent of the original cost, but that this would be lowered in time. Mr. Keenan pointed out that net profits were made only by the selection of the right type of bus to fit the requirements. He further emphasized the fact that the cost of maintenance would be lowered as more buses were put into use and when there was some sort of standardization and accessibility. The inability of repair men to easily work on various parts of the bus means more expensive repairs and a loss of revenue through the enforced idleness of the rolling stock.

Several speakers spoke on body design, schedule operation, fleet management, and other subjects relative to the proper and economical operation of buses.

Railroads Prepare for Equipment Buying

The New York Central lines have applied to the Interstate Commerce Commission for authority to issue 20,955,000 of 4½ per cent equipment trust certificates and other obligations for the purpose of paying 75 per cent of the cost of certain new equipment, as follows:

For the New York Central: eighteen Mikado freight locomotives, $443,420; fifteen Pacific passenger locomotives, $406,993; twenty-five switching locomotives, $871,250; fifteen 70-ft. steel passenger coaches, $416,993; sixteen 73-ft. steel dining cars, $790,880; eighteen 70-ft. steel combination passenger and baggage cars, $476,493; sixty express refrigerator cars, $481,200; twenty-eight horse cars, $511,000; six hundred 55-ton steel box cars, $1,565,436; twenty-six hundred 70-ton steel hopper cars, $6,247,956.

For the Boston & Albany R.R.: five K-5 Pacific locomotives, $320,000; three 73-ft. steel dining cars, $148,200; fifty 70-ft. suburban coaches, $1,099,213; one thousand 55-ton steel box cars, $2,607,060.

For the Michigan Central R.R.: five K-5 Pacific passenger locomotives, $320,000; three 73-ft. steel dining cars, $148,260; twenty 60-ft. steel baggage cars, $391,099; one thousand 55-ton steel box cars, $2,608,700.

For the Big Four

For the Big Four R.R: five K-3 Pacific passenger locomotives, $287,600; twenty-five 70-ft. steel passenger coaches, $694,990; ten 60-ft. baggage cars, $189,855; ten 69-ft. baggage cars, $214,654; five 73-ft. steel dining cars, $246,800; five 70-ft. steel combination passenger and baggage cars, $131,999; six hundred and fifty-five steel box cars, $1,579,712; one thousand 70-ton steel hopper cars, $2,498,150; five hundred 70-ton steel hopper cars, $1,294,400; one hundred and ninety 35-ton refrigerator cars, $589,000.

The Bangor & Aroostook Railroad Co. has applied to the Interstate Commerce Commission for authority to issue promissory notes in connection with the purchase of four consolidation type locomotives, to cost approximately $160,000.

Noted Engineers Help to Make Centenary of Franklin Institute Successful

All countries of the world represented at celebration

With speakers and guests from all parts of the world and with scientists and engineers of renown present, the Franklin Institute celebrated the centenary of its founding in Philadelphia, Sept. 17, 18 and 19. The attendance at the banquet held on the final night of the meeting was approximately 700 people, and it is estimated that the attendance at the sessions held at the University of Pennsylvania was in excess of this figure.

Dean Kimball, of Cornell, in opening his address on, "Progress and Promise of Engineering," quoted from Scripture the fact that Judah, while at war with the Canaanites, was able to drive out the inhabitants of the mountains, but could not drive out the inhabitants of the valley, even though the Lord was with him, because they had chariots of iron.

Enlarging upon this statement, Dean Kimball showed that from time immemorial the people that were in the strongest position and made the greatest progress, were the people who had the best implements and that man has become not only a tool-using animal, but a tool-directing animal. He also said, that the directing of tools of production directed the transmission of intelligence and that science unapplied is useless.

In reply to the much voiced theory that we will soon reach the limit of progress and begin to retrograde, Dean Kimball said that we might be approaching the limit of progress, but if the scientists could bring to the engineers two things—unlimited power and synthetic food—our continued progress would be assured. Modern science having given us the ideals of progress, our future would be what the engineers make it.

"All great inventions have been accepted with alarm," he continued. "Consider with what timidity our stone-age forefathers must have looked upon the first axe. Consider the alarm occasioned by the first use of gunpowder. It is true with all new things and while we may look aghast at synthetic food, nevertheless it is already in the process of being made. One of the world's leading scientists declared a few weeks ago that he had succeeded in making synthetic sugar."

Inventions of the Past Century

Dean Kimball then went into the details of engineering progress, telling of what had been accomplished during the past century and predicting many of the things that were to be. He based his theory on the fact that engineers, unlike the lawyers, were not guided by precedent, but worked things out by new and original theories.

The next address, "Some of the Effects of Loading Granular Material," was by Daniel E. Moran, M.Sc. The subject was confined to tests to determine the behavior of sands under loads when used as a foundation.

The closing address was made by Brigadier General Edgar Jadwin who had chosen "Modern Military Engineering," for his subject. In his address, General Jadwin told what comprised military engineering and gave a résumé of what had been accomplished by military engineers, dwelling upon the activities during the world war. He illustrated by lantern slides some of the marvels of construction in France by the engineers of the American Expeditionary Force.

The meetings ended on Sept. 19 with an especially interesting banquet attended by over 700 from all parts of the world.

In the morning Miss Teresita Bartol Dalley unveiled a tablet in honor of her great-uncle, Henry Welchman Bartol who created and endowed the Foundation which bears his name. The unveiling marked the opening of the Bartol Research Foundation at 127 North 19th St., Philadelphia, which results from a gift of $1,300,000 by the founder.

The sectional meetings which preceded it were held in four different rooms of the University of Pennsylvania and were devoted to a wide variety of subjects, including chemistry, metallurgy, light velocity and modern ordnance, the latter by Major General C. C. Williams, Chief of Ordnance, U. S. A. Dr. A. A. Michelson's fine work on the study of the velocity of light was particularly interesting.

The banquet was held at the Bellevue-Stratford Hotel and the speeches were short and to the point, consisting of very brief introductions of a few representatives of foreign societies, including Prof. Sir Ernest Rutherford of England; Prof. F. Haber of Germany; Prof. Chas. Fabry of France; Lady Parsons of England; Hon. O. H. Lamm of Sweden; Prof. Pieter Zeeman of Holland, and representatives of American colleges.

From All Over the World

An interesting feature was the presentation of written greetings from all over the world, Calcutta, Australia, and Rome, being represented by delegates, in addition to those previously mentioned.

In closing, Dr. William C. L. Eglin, president of the Franklin Institute, gave Dr. Gellert Alleman and his secretary, Miss Kennedy, full credit for the way in which the celebration had been planned and executed. There was not a deviation in the entire program and all the delegates expressed their appreciation of the way in which they had been looked after.

Dr. Schlesinger Talks at New Haven

A meeting of the Central Committee of the Sectional Committee on Small Tools and Machine Tool Elements was held at New Haven, Conn., in connection with the Machine Tool Exhibit, on Sept. 17. H. E. Harris presided. The meeting was to inaugurate work on the standardization of tool holders and tool posts and was attended by tool holder makers, machine tool builders and consumers. A sub-committee, including members of all three elements will be appointed later.

Dr. Schlesinger Speaks

An interesting feature of the meeting was an informal address by Dr. Ing. Georg Schlesinger, Professor of Mechanical Engineering at the Technical High School of Charlottenburg, Berlin, and also Chief of the Testing Laboratory for Machine Tools, which is supported by the 415 members of the German Machine Tool Association. He told of the mistakes made in the beginning by over-centralization of the work but that this had now been remedied by assigning parts of the work to different branches, so that experts could be secured on all the problems. Dr. Schlesinger has been chairman of special committees for 14 years, so that his experience and advice is of particular value.

Dr. Schlesinger emphasized the advisability of confining standardization to what may be called "connecting parts," as tool holding and work holding devices, motor connections, etc. In this way great economy can be effected without limiting the designer in making improvements in the productivity of his machine.

Many machine tool elements have been standardized by the German builders, including spindle noses, tapers and T-slots. Many buyers will not even consider the purchase of a machine which does not conform to the accepted standards and some have gages to which the builder must fit the standardized parts. Dr. Schlesinger's talk was both interesting and helpful to those engaged in standardization work here.

McGraw-Hill Editors Visit General Electric Co.

On Tuesday, Sept. 17, a delegation of twenty-five technical editors of the McGraw-Hill publications visited the Schenectady Works of the General Electric Co. With the editors were James H. McGraw, James H. McGraw, Jr., Edward J. Mehren and Malcolm Muir, executives of the company. Arrangements for the visit were made by Edgar Kobak, assistant to J. H. McGraw, Jr.

The editors went at the invitation of Gerard Swope, president of the General Electric Co., and were his guests at a buffet luncheon in the Mohawk Club where they met many of the company officials. During the morning a visit of inspection to the plant and the research laboratory was the order of business. After luncheon the party broke up, each editor visiting the men in the General Electric Co. whose work was most closely connected with the field of his particular paper.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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IT IS hard to distinguish between the significant and the insignificant in the news of business that is served up to us. It is equally difficult to decide whether many of the happenings chronicled connote prosperity or the reverse. Individually, most of us are gratified when we find that what we buy costs less or lasts longer than formerly, but as merchants, manufacturers, or farmers, we are disturbed by declining prices or smaller sales.

These are the thoughts that suggest themselves to the would-be interpreter of last week's business developments. There is a lack of snap. On the Stock Exchange the trading has been perfunctory and without definite trend. Some highly speculative specialties like the Baking stocks were advanced, but there was no wide public interest.

Advertisements offering "sand, lime and brick for prompt shipment from Europe at very attractive prices" have appeared in the New York papers and lumber, cement and steel are about the only building materials that are not lower. Rubber is also an exception to the declining tendency but the firmness in it is attributed to English rather than American buying. In the steel industry a better demand is reported and pig iron as well as scrap are slightly higher.

Summarizing, it may be said that most of the things that the domestic budget includes are lower. The downward tendency has become sufficiently general to justify the assumption that it is due to some underlying cause as well as to the influences specifically assigned in each case. If the decline continues it will mean a reduction in the cost of living, but this does not seem to be understood, or if understood no one appears to be pleased at the prospect.

Meanwhile the merchants are coming to complain a little. The executive chairman of the Women's Wear League has been exhorting its members to refrain from overstocking and business generally seems to have gone back to the hand-to-mouth policy.

But in the background we have record bank clearings and car loadings with money easier than it has been for years and the largest supply of unused bank credit on record.

What do these contrasting facts mean? To construe them dogmatically would be dangerous, but they seem to indicate that America is waiting for two things. One is the result of the Presidential election. The other is the effect that the rehabilitation of Europe will have upon our domestic trade. There is still a fear that the choice of a president will devolve upon the House of Representatives and it is also feared that European competition may compel a reduction in industrial wages in this country.

In New England where a "prosperity drive" to aid home products is being conducted, a lower wage scale has been concurrently announced in some cotton mills. The two things may seem somewhat inconsistent, but they are not, for cheaper production costs are in reality essential to prosperity. That the proposed reduction will be opposed by the trade unions goes without saying; but "needs must" is a hard argument to combat and in the present case it is likely to prove irresistible.

The textile industry is not the only line in which production has caught up with the demand at present prices. The building business is another and bricklayers, plasterers, painters and other mechanics may soon have to choose between unemployment, lower wages, or more work for the same money.

During the war the painters discovered that their health would be injured if they inhaled the fumes of turpentine on Saturday. Thereupon they decided to work only five days a week. Their example was followed in some other trades and in the larger cities building operations are practically suspended from Friday afternoon until Monday morning. It has also come to pass that in many offices and industrial establishments but little work is done on Saturday.

Now it begins to be apparent that we cannot continue to spend lavishly unless we also work lavishly. The prevailing blindness to this truism is the only thing that is the matter with business in this country. Economic law now seems to be operating as a school master to bring us to a realization of the need of work as a condition of prosperity. This is the encouraging aspect of the situation, and it is encouraging even though it may mean a short period of quiet trade and enforced economy.

In New York short time funds are somewhat easier as capital is being accumulated here in large amounts. But rates elsewhere in the United States are a shade stiffer and the weekly statement of the Federal Reserve System shows a decline of nearly 2 per cent in the reserve ratio which now stands at 78.5 per cent as against 80.3 per cent at the end of the previous week. The decline is chiefly due to an increase of $123,000,000 in member bank deposits. Nearly all of this increase is reported by the New York banks.

As far as the figures are significant they suggest that at the present low rates forehandedness in borrowing will be wise.

What's Doing in Industry

Better business is reported from all parts of the country in the machinery and machine tool market and these reports are based upon actual sales and inquiries received during the past ten days. The improvement is due to increased railroad buying, increased car and locomotive building, a slight speeding up in automotive production and a demand from general industrials dependent upon the other major sourecs.

The future of the machine tool business looks brighter this week than it has for some time past. About a month ago inquiries began to come in but orders did not follow. At this time orders are being received and there has been no let-up in the number of inquiries. This business marks a steady improvement, as no large or unusual orders have been received. Most dealers view this condition with more favor than if it had been caused by abnormal conditions or unusual buying.

The electric companies are also showing signs of interest in the machine tool markets which is welcome, especially in the Eastern markets that this time lagged behind the midwest and Western markets.

General business has improved and, although some lines are slow, there is very little complaint heard.

Stocks took on a more even tone this week and the volume of business was good. Sales are exceeding those of last year and the average is higher for most classifications. Motor and rail stocks both hold steady at good prices and are less affected by speculative movements than industrials and specialties.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Indianapolis

Demand for tools and metal working machinery continues to expand both in Indianapolis and throughout Indiana. Business seems to be exceptionally good with the automotive industry and its allied trades. Most local automobile factories continue to increase their production and in some instances it is declared that the prospects are bright. These manufacturers say their dealers in smaller cities dependent largely on the rural trade, report conditions improving rapidly. According to O. B. Iles, head of the International Machine Tool Co. here, there continues to be a volume of inquiry that is certain to lead to good business. He is optimistic concerning the coming winter. Sales of heavy machinery, particularly, are picking up slightly.

A noticeable increase has come from the woodworking plants in central Indiana, the demand being for specialized machinery. The furniture industry is exceptionally prosperous at this time and the local veneer plants seem to have a satisfactory volume of orders that will insure production until after the first of the year at the present rate. The railroads are increasing their demands slightly, though more business is expected from this source when the outdoor repair work is stopped.

The last two weeks have seen a good demand from the coal fields. Mines that have been down all summer are opening and as is usual when operations have been stopped for some time, new machinery and tools are necessary.

Canada

There is no question as to the continued improvement of the metal-working industry in Canada. Everything points that way. Tonnage figures on metals, machinery, etc., shipped by rail to Canadian and foreign destinations are a reassuring sign of the upward swing. While the Aug. 23 total was 50,888 tons, that for Aug. 30 was 51,955 tons. Reports from all sections of the country are to the effect that the market for machinery and machine tools is improving. There is still a considerable call for second-hand equipment in the smaller machines, but several large sales have recently been put through, and many manufacturers are seeing the wisdom of adding to their equipment only new machinery.

Among a number of encouraging reports is that of the managing director of Canadian Vickers, Ltd., who states that his firm has at least five months' work ahead in the shops. The marine and ship repair plant, the structural steel shop, airplane division, and the mining and industrial machine plant are all at work and have big jobs ahead of them. There is considerable activity in paper-making and mining.

With the usual fall overhauling of plant equipment in full swing, boiler tubes show a large increase in sales, and are moving as freely, if not more so, than any material handled by the warehouses. The iron and steel scrap market in Toronto shows a slight advance in sales. One dealer reports a 60 per cent increase in business during August, as compared with July. The pig iron market continues firm, sales at Montreal and Toronto being reported as fair. The old material situation has shown slight improvement with increased sales reported in Toronto.

Considerable interest was taken in the exhibits of the metal working field at the Canadian National Exhibition at Toronto. Two or three firms obtained gratifying orders the first week and one exhibitor made a fairly large sale of expensive equipment within a few hours after the fair opened.

New York

Improvement in both sales and inquiries was noted this week in the machinery and machine tool markets of New York. The inquiries have been received in good volume for the past three weeks and this week orders followed to a fairly good degree. Buying by all of the Eastern railroads of necessary shop tools was noted and inquiries were received from the General Electric Co., the Western Electric Co., and the American Locomotive Co. Car builders as well as locomotive builders have received good orders within the past month and the purchase of machine tools is expected within the next month from this source.

Radio receiving set makers in and around New York and New Jersey were in the market last week for machine tools and some sales were reported. This business is becoming a steady source of small sales and dealers are appreciative of its value, especially in slack times.

Automobile accessory makers bought sparingly during the week, but indications are for heavier buying from this source. For the past two months buying was almost at a standstill among the accessory people.

Used tools improved a little during the past week and the call from Southern textile factories for used machinery was noted.

Export business still keeps up at a good pace and shippers from the port of New York are well pleased with the volume of business so far this year.

There is still great anticipation of improved business in October, although many of the dealers feel that nothing of importance will be purchased before election. Others are of the opinion that election will not influence business one way or the other and that buying will commence as soon as business warrants and as necessity arises.

Detroit

Improvement in the market for machinery and machine tools has been the experience of the leading dealers in Detroit and its environs during the past few days, a survey indicates.

Material increase in automobile production, better employment in most plants, and a general improvement in manufacturing through the entire state have combined to cause a more optimistic feeling for the remainder of the year.

Reports of the steel market show that September has seen a considerably broader market for steel in the automotive industry than existed during August. At the same time many of the accessory plants are finding larger orders which mean corresponding purchases in the way of new equipment.

Expectations that the machine tool business during October and November will be normal are freely expressed by leaders in the field. Changes within plants and building alterations providing more space in which to conduct operations are helping to make the immediate future brighter.

Southern District

With some improvement noted since the first of the month in sales of equipment to the textile industries in the South, and railroads still buying heavier machinery and tools on a fairly active basis, the situation in the South continues to show a slow but steady betterment, larger dealers advising that at the present rate September business will slightly exceed August, and prove considerably better than the corresponding month in 1923.

The most encouraging factor is the improvement in the textile industries, which have been buying on a very slow basis for several months past, and though conditions still are far from the best, the outlook is better than it has been in more than half a year. Through the fall and winter months an improvement in sales to this source is looked for by the trade, while next spring, if nothing unforeseen occurs, should prove decidedly active, dealers believe.

Railroad sales, which generally begin to slow up considerably about this time each year, have been as active as usual

during the month so far, and with some additional big shop projects announced by Southern roads the outlook portends continued good business for another month at least. Officials of the Southern Railway System have just approved a new $1,500,000 project for Atlanta, and work will start shortly. Shop facilities costing $1,500,000 are also contemplated at Erwin, Tenn., for the Clinchfield Railway by the Atlantic Coast Line and the Louisville & Nashville, while a number of other similar projects are underway in various parts of the Southeast.

New construction in the foundry and machine shop field throughout the district the past month or so has also served to swell the volume of sales, a larger number of such projects planned for this fall than during any late year period of the past half decade. Some of the projects announced the past month exceed $100,000 each, including the rebuilding of the Hardie-Tynes machine shops at Birmingham, Ala., destroyed by fire recently at a loss of about $750,000.

Milwaukee

Sentiment with respect to the state of the metal-working industries is less conflicting, and shows substantial improvement, although in figures, the number of purchases of new equipment has made but a scanty gain. It is generally understood that one of the first steps toward improvement in business is a change in sentiment and opinion, and now that this seems to have been brought about by the more cheerful tone in business conversation, the expectancy is that the hopes of better trade will be fulfilled.

Local foundries and machine shops report increasing orders, but not of such amount that existing facilities are subjected to pressure making necessary substantial additions to equipment or extensions of buildings. This state of affairs is keeping the demand for machine tools closely limited to actual needs. Shops as a rule are operating on current orders, there being no disposition on the part of most customers to anticipate requirements of materials and parts for a long time ahead, as in former times.

Even in the automobile industry, makers of passenger cars are placing orders for units, parts and equipment for only a short time ahead, in line with the policy being adopted generally to keep production schedules under the strict government of the current sales to users. Ordinarily manufacturers have contracted for supplies for as long as a year ahead, with suitable reservations as to delivery specifications, but in most cases this is no longer being done. In the absence of exact knowledge as to requirements in the period past 30 or 60 days, manufacturers of materials and parts are proceeding slowly with equipment buying and are placing orders only when the need exists and occupancy of the additional capacity is quite well assured.

Commencing with the early part of August, there has been a slight but gradual upward curve of the line describing employment.

Pittsburgh Plus Plan Is Abandoned

The United States Steel Corp. and its subsidiaries have abandoned the so-called Pittsburgh plus system without a fight and will not quote or sell their rolled steel products upon any other basing point than that where the products are manufactured or from which they were shipped. Other steel companies have followed this example.

The Federal Trade Commission was so informed recently when the Steel corporation and its subsidiaries filed with that body a report to the effect that they would comply with the order issued by the commission July 22, which directed the corporation and its subsidiaries to abandon the Pittsburgh plus system. The action of the commission was based on the finding that it was an unfair method of competition, in violation of the Federal Trade Commission act, and price-discrimination in violation of the Clayton act.

The Pittsburgh plus system was the one used by the steel corporation and its subsidiaries in quoting prices on rolled steel products manufactured at and shipped from their plants outside the Pittsburgh district at a Pittsburgh base price, plus an amount equivalent to what the railroad freight charge on such products would be when actually shipped from Pittsburgh.

National Industrial Advertisers' Meeting

To bring together the best experience of manufacturers who sell to industry, the National Industrial Advertisers' Association will hold a two-day meeting in Chicago, Oct. 13 and 14.

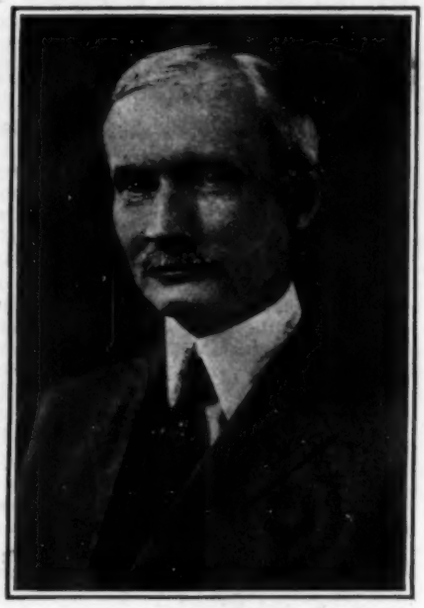
Presidents, advertising and sales managers of important companies have accepted places on the program.

Among the papers thus far scheduled are the following: "Problems in Technical Research," by P. C. Gunion, the Hyatt Roller Bearing Co.; "Relations between Advertising and Sales Department," by Julius S. Holl, the Link Belt Co.; "Building a Large Industrial Business with Advertising," by R. C. Beadle, the Combustion Engineering Corp.; "Selling by Film," by R. E. Conder, the Boston Woven Hose & Rubber Co.; "What Our Company Is Doing in Intensive Sales Work," a group of five-minute talks by W. L. Schaeffer, the National Tube Co.; Edwin L. McFalls, the Master Builders Co.; Francis P. Bowman, the Carborundum Co., R. F. Woods, the Autocar Co.; and E. J. Smythe, the Fuller & Johnson Mfg. Co.; "The Source of Data in Industrial Advertising," by Ezra W. Clark, the Clark Trucktractor Co.; "What Manufacturers Can Do Through United Effort to Secure Better Industrial Advertising," by P. L. Thomson, the Western Electric Co.

The meetings will be held at the Edgewater Beach Hotel, Chicago, and further information can be secured by addressing H. L. Delander, acting secretary, National Industrial Advertisers' Association, 836 So. Michigan Ave.

Obituaries

GEORGE C. BARDONS of the firms, Bardons & Oliver and Joseph Lyon & Son, Cleveland, whose death was reported in the Aug. 7 issue of the *American Machinist*, was born in Brooklyn Nov. 24, 1860. Shortly after his birth the family moved to Hartford, Conn., and, due to the death of his father in the Civil War, Mr. Bardons



George C. Bardons

went to work at the age of 12 years. When he was 14 years old he went with the Pratt & Whitney Co. where he operated a milling machine, but due to his youth and lack of stature, he had to stand on a box in order to reach the machine.

He remained with this company until 1880 when Worcester R. Warner and Ambrose Swasey decided to start in business in Chicago. They took with them several Hartford men including Mr. Bardons. When the new firm moved to Cleveland a year later Mr. Bardons was made a foreman. After a short time with this firm he started out after experience, working in several shops in various parts of the country, but in 1884 he returned to Warner & Swasey as a foreman. A few years later he was made superintendent, a position that he held until 1891 when in company with John G. Oliver he organized the firm of Bardons & Oliver.

While with Warner & Swasey, Mr. Bardons had charge of the construction of the Lick Observatory telescope, at that time the largest refracting telescope in the world.

In 1897 Mr. Oliver and Mr. Bardons took over the forging business of Joseph Lyons & Son which has been continued as a separate business.

Mr. Bardons was highly thought of in the machine tool industry where he was well known for the past forty years. His ability as a mechanic as well as his business acumen made his advice valuable and often sought.

SAMUEL H. EDLIN, 63 years old, president of S. H. Edlin & Co., dealers in concrete mixing machinery, Indianapolis, Ind., died recently of heart trouble.

CHRISTOPHER E. PRICE, formerly secretary and treasurer of the M. Seward & Sons Co. before the dissolution of that company, died recently at his home in New Haven, Conn.

WILLIAM AIRD, aged 87 years, former superintendent of the Canadian Locomotive Co.'s works at Kingston, Ontario, died at his home in Barrie, Ontario, Sept. 10.

Personals

JOSEPH F. PFLUM who has been the manager of the Cincinnati branch of the Heald Machine Co., Worcester, Mass., will in the future have charge of the Cleveland branch also. R. A. ST. JOHN will assist Mr. Pflum.

MARTIN G. SPERZEL has been made vice-president and general manager of the Royersford Foundry & Machine Co., Royersford, Pa.

CHARLES M. WALTON, assistant superintendent of power and plant, the Yale & Towne Manufacturing Co., New Britain, was presented by the employees of the company with a platinum cased watch and chain in celebration of his fiftieth year with the organization.

WILLIAM H. BALDWIN has been elected president of the Baldwin Tool Works, Parkersburg, W. Va., succeeding his father, the late FRANK M. BALDWIN.

LEROY E. JOLLS, of Detroit, has been appointed mechanical superintendent of the Nordyke & Marmon Co., Indianapolis.

R. W. PAYNE has been appointed Southern sales manager of the Verona Tool Works, Pittsburgh, with headquarters at 613 Fifteenth St., N. W. Washington, D. C.

W. R. WILLIAMS has been appointed sales manager for the Richmond, Va., district by the Standard Stoker Co., New York City..

F. H. CLERGUE, a director of the Canadian Car & Foundry Co., has returned to Canada after a three months' visit in Europe.

V. H. DAY and B. M. PRICE have been appointed as regional vice-presidents of the General Motors Truck Co. Mr. Day will have headquarters at San Francisco and Mr. Price will be located in New York.

H. E. ROBERTSON, formerly general manager of the Larco Wrench & Manufacturing Corp., is now vice-president and treasurer of the Goetz Brass Co., 630 N. Franklin St., Chicago.

LOCKETT C. COLEMAN, formerly assistant general manager of the Boston & Maine R.R., has accepted a position in the locomotive department of the Ingersoll-Rand Co., New York City.

ALLAN S. MUIRHEAD of Toronto has been appointed vice-president, and W. S. GOODEVE, general manager, of the Gray-Dort Co., Chatham, Ontario.

MORRIS MILLER and NATHAN ROSENBERG, of Green Bay, Wis., have acquired the plant and other assets of the defunct J. F. Davis Sons Co., at DePere, Wis., originally known as the Lyons Boiler Works, and plan to resume the operation about Oct. 1. The plant is equipped for fabricating structural materials, boilers, conveyors, digesters and other paper and pulp mill machinery, and also for producing a special steel motor truck wheel.

DON C. MCCORD and MAURICE ROTHSCHILD, who control the Apperson Automobile Co., Kokomo, Ind., have leased the plant of the Haynes Automobile Co. and will organize the Haynes Motor Corp. to operate it. Creditors of the Haynes company, against which bankruptcy proceedings are pending, have been offered 15 cents on the dollar for their claims.

J. CARLTON WARD, JR., is factory manager of the Pratt & Whitney Co., Hartford, Conn., instead of assistant manager as was announced.

FRANK A. WILCH, who has been associated with the Cleveland office of the Triumph Electric Co. has been placed in charge of that territory. He succeeds EDWARD S. FORD.

Business Items

The Dalton Manufacturing Corp., South Beach, Conn., has been succeeded by the Dalton Tool Corp., a company composed of old employees of the Dalton Manufacturing Corp. The Dalton Tool Corp. will be located at Willow Ave. and 133rd St., New York City.

An agreement has been made whereby Jacques Vieyra, 24 Rue de Lubec, Paris, will manufacture the products of the J. F. Buhr Machine Tool Co., Detroit, Mich., in Europe.

The International Tool Co., Dayton, Ohio, is a new concern that has been granted incorporation papers. Its incorporators are J. J. Kohl, Milton T. Ahlers, Robert W. Ziegler, Fred Schulz, and Albert J. Henn.

The Columbus Anvil & Forging Co., Columbus, Ohio, has been incorporated with a capital of $50,000. The incorporators are A. J. Fox, W. T. Joseph, W. B. McLesky, A. D. Whitelaw and R. W. Richardson.

The Studebaker Corp. of Canada, Ltd., announces the operation of a direct factory branch in Montreal to care for its business in the province of Quebec.

De Dietrich & Cie., France, one of the oldest companies in the world manufacturing enameled apparatus, have appointed the Chemical & Vacuum Machinery Co., Inc., Buffalo, N. Y., as their sole American representatives.

The Simonds Saw & Steel Co., Fitchburg, Mass., has purchased an additional building in South Boston, Mass., to be used as a manufacturing and distributing plant.

The Bristol Brass Co., of Bristol, Conn., resumes operations on a 55-hour weekly schedule this week. Since last spring the plant has operated only 40 hours weekly.

The Dominion Sheet Metal Corp., Hamilton, Ontario, has sold a large interest in its business to John Lysaght, Ltd., of Bristol and Newport, England, which is expected to bring business expansion to this industry. The deal is the result of a visit to England recently by A. T. Enlow, president, and C. B. Enlow of Evansville, Indiana, vice-president of the Dominion Sheet Metal Corp.

The Economy Railway Appliance Co. Ltd. has been incorporated under federal charter in Canada. The new corporation is capitalized at $300,000 and will deal in all kinds of railway supplies, appliances and equipment. Headquarters will be in Montreal.

The Rotary Valve Co., Evansville, Ind., with a capital of $60,000, has been incorporated as a manufacturing concern. The directors are A. F. Caden, W. R. Caden, W. J. Gyger, Charles Moore and Myles M. Moore.

Stockholders of the Lafayette Motors Corp. have approved the sale of all its assets, except cash, receivables, securities, cars in stock, name and good-will, to the Ajax Motors Co. for $225,000 in cash, and the dissolution of the corporation.

The Consolidated Products Co., Inc., New York, has purchased outright, the American Hominy Co.'s plant at Indianapolis, Ind., including all equipment and real estate.

The Nakashima Co. is now located at 5 Chome, Tosobori-dori, Nishiku, Osaka, Japan.

The Roller-Smith Co., 233 Broadway, New York, announces the appointment of the Thrall Electric Co., Presidente Zayas No. 27 & Esquina A Habana, Havana, Cuba, as its exclusive representative for the Island of Cuba.

Forthcoming Meetings

National Safety Council. Thirteenth Annual Safety Congress. Louisville, Ky. Sept. 29 to Oct. 3. W. H. Cameron, managing director, 168 N. Michigan Ave., Chicago.

Motor and Accessory Manufacturers' Association. Annual meeting, Cleveland, Ohio. Week of Oct. 6, 1924.

American Foundrymen's Association. Twenty-eighth annual convention. Milwaukee, Wis. Week of Oct. 13, 1924.

National Industrial Advertisers Association. Annual meeting, Edgewater Beach Hotel, Chicago, beginning Oct. 13, 1924.

Management Week. Under the auspices of the American Society of Mechanical Engineers. Week of Oct. 20, 1924. Simultaneously held in leading cities.

American Gear Manufacturers Association. Semi-annual fall meeting. Briarcliff Lodge, Briarcliff Manor, N. Y., Oct. 16, 17 and 18. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Production meeting. General Motors Building, Detroit, Mich., Oct. 22, 23 and 24. C. S. Clarkson, secretary.

American Society of Mechanical Engineers. Forty-fifth annual meeting. New York City. Dec. 1 to 4. Calvin Rice, secretary, 29 West 39th St., New York City.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 1 to 4. Charles F. Roth, 1102 Grand Central Palace Building, New York City.

Exposition of Invention. Engineering Societies Building, 29 West 39th St., New York City. Dec. 8 to 13 inc., General offices, 47 West 34th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Pig iron firmer at $18@$18.50 per ton for No. 2 foundry, Southern. Slight improvement in iron buying during the week. Weakness continues in steel. Bars touched minimum of $2 per 100 lb., Pittsburgh this week, with maximum at $2.10. Shapes are $1.90@$2 and plates, $1.60@$1.90 per 100 lb., f.o.b. mill. Iron and steel scrap is advancing steadily. Railway material continues to hold the lead in steel demand.

Non-Ferrous Metals—Domestic copper demand fairly active; price down about ¼c. from Sept. 12 level. Tin higher abroad; local quotations 3c. under Sept 12. Lead market easier, although price is ¼c. per lb. above week ago. Zinc quiet with prices unchanged. Antimony up ¼c. per lb.; market uncertain owing to Chinese situation.

(All prices as of Sept. 19)

IRON AND STEEL

PIG IRON—Per gross ton—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$22.05@22.55
Northern Basic	20.00
Southern Ohio No. 2	21.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.05
BIRMINGHAM	
No. 2 Foundry	18.00@18.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.77@22.27
Virginia No. 2	28.44@29.44
Basic	20.00@21.00
Grey Forge	21.22
CHICAGO	
No. 2 Foundry local	20.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.05
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	22.77
Basic	22.77
Bessemer	25.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	6.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.65@2.70	3.89	3.55	3.80
No. 12	2.75@2.80	3.94	3.60	3.95
No. 14	2.85@2.90	3.99	3.65	4.00
No. 16	3.05@3.10	4.09	3.75	4.10
Black				
Nos. 17 and 21	3.25@3.35	4.40	4.25	4.55
Nos. 22 and 24	3.30@3.40	4.45	4.30	4.55
Nos. 25 and 26	3.35@3.45	4.50	4.35	4.60
No. 28	3.40@3.50	4.60	4.45	4.50
Galvanized				
Nos. 10 and 11	3.55@3.60	4.60	....	4.60
Nos. 12 and 14	3.65@3.70	4.70	....	4.70
No. 17 and 21	3.95@4.00	5.00	....	5.00
No. 22 and 24	4.10@4.15	5.15	5.00	5.15
No. 26	4.25@4.30	5.30	5.25	5.30
No. 28	4.55@4.60	5.60	5.55	5.50

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv
1 to 3 in. steel butt welded	48%	34%	55½%	43½%	56%	43%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	53%	40%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.09	50%	¾	$0.16	35%
⅜	.11	45%	1	.18	31%
½	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	7.50	8.00	6.55
Hoop steel	4.49	3.85@4.35	4.15
Cold rolled strip steel	7.00	8.25	7.15
Floor plates	5.55	4.60	5.50
Cold drawn shafting or screw	4.15	3.90	3.80
Cold drawn flats, squares	4.65	4.40	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.42½	3.10
Bar iron (2.90@3.00 at mill)	3.24	3.21	3.00
Tool steel	11.00	....	....
Drill rod (from list)	60%	40@55%	50%

Electric welding wire, New York, ⅛, 8.35c.; ¼, 7.85c.; 5/32 to ½, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.75
Tin, 5-ton lots, New York			48.50
Lead (up to carlots), St. Louis	7.87½	New York	8.75
Zinc (up to carlots), St. Louis	6.17½	New York	7.00

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	27.10	28.00	28.50
Antimony (Chinese), ton spot	12.00	13.00	10.00
Copper sheets, base	20.62½	20.87½@21.25	23.00
Copper wire, base	19.00	19.00	21.75
Copper bars, base	19.87½	22.25	22.50
Copper tubing, base	22.75	28.00	25.75
Brass sheets, base	17.25	21.75	19.75
Brass tubing, base	21.50	28.00	28.25
Brass rods, base	15.00	17.75	17.50
Brass wire, base	17.75	21.75	20.25
Zinc sheets (casks)	10.60	11.10	....
Solder (½ and ½), (case lots)	38.00	35.00	30.00
Babbitt metal (83% tin)	60.00	58.00	48@52
Babbitt metal (35% tin)	28.00	19.00	23@26
Nickel (ingot and shot) f.o.b. refinery	27.00	....	....
Nickel (electrolytic) f.o.b. refinery	30.00	....	35.00
Nickel (F shot) f.o.b. refinery	30.00	....	....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54. 00
Manganese nickel hot rolled rods "D"—high manganese (base) 57. 00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32. 00	Hot rolled rods (base)	40. 00
Blocks	32. 00	Cold drawn rods (base)	48. 00
Ingots	38. 00	Hot rolled sheets (base)	42. 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	10.75@11. 25	11.00	11.00
Copper, heavy, and wire	10.50@11. 00	10.75	10 50
Copper, light, and bottoms	9.25@ 9.50	9 25	9.50
Heavy lead	6.25@ 6.50	6.00	7.00
Tea lead	5.25@ 5. 50	4.50	5.50
Brass, heavy, yellow	6. 50@ 6. 75	6. 50	7.00
Brass, heavy, red	8. 50@ 8.75	....	8.50
Brass, light	5. 50@ 5. 75	5.50	6.00
No. 1 yellow rod turnings	7.00@ 7.50	7.00	7.00
Zinc	3.75@ 4.00	3.75	3.50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$23. 50	$22. 85	$21. 00
"A" Grade:				
IC,	20x28, 112 sheets	19. 00	18. 00	17. 00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	13. 00	13. 00	12 75
	Terne Plates—Small lots. 8-lb. Coating			
IC,	14x20	7. 25	6.80@6.90	6.50@6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 14@0. 21	$0. 19	$0. 14
Cotton waste, colored, per lb.	. 09@ .14½	.18	. 10½
Wiping cloths, 13½x13½, per lb	11. 25*	36. 00 per M	. 16
Wiping cloths, 13½x20½, per lb.	....	52. 00 per M	. 16
Sal soda, per 100 lb.	2. 40	2. 25	2. 65
Roll sulphur, per 100 lb.	3. 60	3. 25	3. 50
Linseed oil, per gal., 5 bbl. lots	1. 04	1. 16	1. 05
Lard cutting oil, 25% lard, per gal.	. 55	. 50	. 32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	. 35	. 21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber transmission:			
First grade	50%	50–10%	40–10%
Second grade	50–10%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$4. 86	$5. 84	$6. 48
Emery paper	10. 71	11. 00	8. 80
Emery cloth	28. 00	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 49	1. 24	1. 40
Cloth	3. 38	2. 67	3 20
Fire clay, per 100 lb. bag		. 65	. 60
Coke, prompt furnace, Connellsville	per net ton		3. 00@3. 25
Coke, prompt foundry, Connellsville	per net ton		4. 25@4. 75
White lead, dry or in oil	100 lb. kegs		New York, 14. 75
Red lead, dry	100 lb. kegs		New York, 14. 75
Red lead, in oil	100 lb. kegs		New York, 16. 25

*White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0. 0324	$0.0354
Cold finished shafting	per lb.	0.0415	0.0415	0.0465
Brass rods	per lb	0.15	0.1475	0.1575
Solder (½ and ½)	per lb.	0.385	0.375	0.295
Cotton waste	per lb.	.14@.21	.14@.21	10@13
Washers, cast iron (⅛ in.)	per 100 lb.	6.50	6.50	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	0.55	0.55	0.55
Machine oil	per gal.	0.29	0.29	0.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	50%	50%	40–10%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	50%	60–10–5%	60%
1½ and 1½x3 in. up to 12 in.	15%	.....	....
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	40%	$3. 50 net	.....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	45%	3. 50 net	60%*
Button head bolts, with hex. nuts	10%	List net	.....
Hex. head and hex. nut bolts	10%	.....	.....
Lag screws, coach screws	50%	.....	65%
Square and hex. head cap screws	75%	75–10%	.....
Carriage bolts, up to 1 in. x30 in.	40%	60%	55%
Bolt ends, with hot pressed nuts	50%	.....	60%
Tap bolts, hex. head, list plus	35%	.....	$4.65
Semi-finished nuts, ⅜ and smaller	70%	.....	.....
Semi-finished nuts, ½ and larger	65%	70%	.....
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6. 50	$4. 00	$3.75
Washers, cast iron, ⅝ in., per 100 lb. (net)	5. 50	4. 00	3.75
Washers, round plate, per 100 lb. Off list	1. 50	4.75	4.50
Nuts, hot pressed, sq., per 100 lb. Off list	1. 50	4.00	4.00
Nuts, hot pressed, hex., per 100 lb. Off list	1. 50	4.00	4 00
Nuts, cold punched, sq., per 100 lb. Off list	1. 50	4.00	4.00
Nuts, cold punched, hex., per 100 lb. Off list	1. 50	4.00	4.00
Rivets:			
Rivets, ⅞ in. dia. and smaller	50%	60–10%	70%
Rivets, tinned	50%	60–10%	70%
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb. (net)	$5. 00	$3. 50	$3. 50
Cone heads, ditto (net)	5.20	3.60	3. 70
1½ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0. 25	.....	0. 15
½ in. diameter *EXTRA*	0. 35	.....	0. 15
½ in. diameter *EXTRA*	0. 75	.....	0. 50
1 in. long, and shorter *EXTRA*	0. 75	.....	0. 50
Longer than 5 in. *EXTRA*	0. 50	.....	0. 25
Less than 200 lb. *EXTRA*	0. 50	.....	0. 50
Countersunk heads *EXTRA*	0. 45	.....	...

*Squa--

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ala., Birmingham—W. M. Smith and Co.—wheel press, 200 tons or larger.

Calif., Burbank—Burbank High School Dist., E. Jones, Clk.—one 20 in. shaper, two 14 in. x 6 ft. lathes.

Ill., Chicago—Chicago Bridge & Iron Works, 2105 Transportation Bldg.—overhead electric cranes for Greenville, Pa.

Ky., Middleboro—J. H. Hoe & Sons, Inc.—power bending brake, ¾ in. plate, 10 ft. long.

Mass., Everett—Market Forge Co., Garvey St.—swaging machine.

Mass., Montello—Mahwhinney Last Co.,—several mortiser and tenoner machines.

Mass., Worcester—Johnson and Bassett, Inc., 114 Foster St.—metal working machinery.

Mich., Detroit—C. Marx, 1615 Ford Ave.—one table making machine Arthur Colton type.

Mo., Centralia—Chance Co.—double disc grinders.

Nebr., Kearney—City, c/o M. E. Burke, Clk.—6-ton traveling crane including hoist and trolley crane, geared end trucks and track.

Neb., Omaha—The Heck-Bastian Electric Co., 314 South 10th St.—drill press automatic or sensitive feed, about 10-in. swing. (Used.)

N. Y., Jamestown—Jamestown Metal Desk Co.—lathes, punch presses, welding equipment.

O., Canton—Timken Roller Bearing Co., A. J. Sanford, Director of Purchases—machinery for new $500,000 rolling mill. This corrects report in September 11 issue.

O., Cleveland—Bd. of Education, Rockwell Ave., H. E. Bopple, Purch. Agt., is receiving bids on the following: variety saw bench, hand joiner 12 in. American, band saw 30 in., oil stone grinder, Burke 10 in. sensitive drill press, U. S. grinder, lathe, 30 in. Niagara square shears, 30 Pexte bar folding machine, punch and shear combined, 30 forming rollers, hand forge, burring machine, turning machine, wiring machine.

O., Columbus—Auto Motive Lighting System Co., 138 East Spring St., C. F. Young, Pres. (Auto devices)—15 stamping machines, slotter and other equipment for factory.

O., Newcomerstown — Newcomerstown Lumber Co., J. H. Asher, Purch. Agt.—Universal wood working machine.

Pa., Bradford—Bradford Brick and Tile Co.—36 in. x 14 ft. or 16 ft. Cincinnati or Gray planer.

Pa., Pittsburgh—Fort Pitt Bridge Works—overhead electric crane for Canonsburg, Pa.

Tenn., Nashville—E. W. Cooper, 174 West 3rd Ave., Engr.—overhead electric crane 40 to 50 ft. span—20 ton or more capacity.

Tenn., Nashville—Nashville Bridge Co., Shelby Ave.—angle shear for small angles 3 x 3 in.

N. S., New Glasgow—Mackay and Fraser, Ltd., R. H. Mackay, Purch. Agt.—mechanical equipment for new plant to manufacture automobile springs.

Ont., Bolton—C. Poble—grinder, boring machine.

Ont., Campbellford—Carson Bros.—drill press, grinder and small tools.

Ont., Campbellford—Meyers & Stone—drill, tapper and reamer.

Ont., Hastings—E. J. Lynch—grinder, lathe, drill press.

Ont., Gananoque—Seal Brothers, Stone St., A. Seal, Purch. Agt.—miscellaneous machinery for garage and repairs.

Ont., Kingston—T. G. Bishop, King St., (Machine shop)—small lathe, miscellaneous tools and other equipment.

Ont., Kirkfield—G. V. Dunn—equipment for garage and repair shop.

Ont., Norwood—J. McLean—milling machine and planer.

Ont., Omemee—W. J. Irwin—lathe, chuck and compressor.

Ont., Pembroke—W. Beatty—planer, sticker and mortiser.

Ont., Pembroke—Desrochiers Bros., 83 Lake St.—grinder, lathe and probably milling machine.

Ont., Peterboro—Mather & Nelson, R. R. 8,—drill, grinder and bench lathe.

Ont., Renfrew—L. Imbleau & Son—additional foundry equipment for proposed expansion.

Ont., Schumacher—Feldman Timber Co., Ltd., A. Feldman, Tisdale, Purch. Agt.—complete equipment for saw mill.

Ore., St. Eugene—Lacelle and Fils—planer, edger, saws, etc.

Ont., Summerstown—F. Leplante,—woodworking equipment, small lathe.

Ont., Warkworth—A. B. Armstrong—lathe, compressor and miscellaneus tools.

Que., Isle Verte—Brown Corporation—equipment for saw mill.

Que., St. Jerome—C. Durand—mortiser and tenoner.

Opportunities for Future Business

Calif., Oakland—Eagle Body Mfg. Co., 501 South Market St., San Jose, H. Sibley, Mgr., plans the construction of a factory on 48th Ave. Cost will exceed $40,000.

Calif., San Francisco—Premier Spring & Bed Co., 2401 17th St., awarded the contract for the construction of a 2 story, 90 x 490 ft. factory on 3rd and Bancroft Sts. Estimated cost $200,000.

Conn., Bridgeport—D. W. Flint, Allens Ave., Providence, R. I., awarded the contract for the construction of a 2-story, 160 x 130 ft. garage on West & State Sts. Estimated cost $150,000.

Ill., Cicero—General Mill Works Co., 1315 West Congress St., is having preliminary plans prepared for the construction of a 2 story mill on 18th and 52nd St. Estimated cost $100,000. Private plans.

Ill., East St. Louis—Standard Oil Co., 400 East Cerro Gordo St., Decatur will soon receive bids for the construction of a 1 and 2 story warehouse and garage building on McCausland and 14th St. Estimated cost $175,000. Schlinz and Bailey, Monadnock Bldg., Chicago, Archts.

Ill., Edwardsville—Western Tie and Timber Co., Syndicate Trust Bldg., St. Louis, Mo., is having preliminary plans prepared for the construction of a tie plant on 316-acre tract. Private plans.

Mass., Boston—A. De Stefano, Chelsea St., East Boston, is having plans prepared for the construction of a 1 story 110 x 160 ft. repair and service garage. Estimated cost $60,000. S. E. Moffie, 51 Cornhill, Boston, Archt.

Mass., Boston—Tileston, Hollingsworth Co., 211 Congress St., plans an addition to plant on River St. Estimated cost $45,000. Architect not selected.

Mass., Chelsea — Standard Box Co. awarded the contract for the construction of a 3-story addition to factory on Gerrish Ave. Estimated cost $55,000.

Mass., Roxbury (Boston P. O.)—H. E. Cline, 43 Tremont St., Boston, will build a 1 story 125 x 60 ft. repair and service garage at 2000 Washington St. Estimated cost $45,000. Private plans.

Mass., Springfield—Boston & Maine Railroad, North Station, Boston, plans the construction of a roundhouse and machine shop. Estimated cost $60,000. F. A. Merrill, Ch. Engr.

Mo., St. Louis—Laclede Gas Light Co., Eleventh and Olive Sts., is having preliminary plans made for the construction of a 2 story service building and shop department on Forest Park Blvd. Estimated cost $300,000. Private plans.

O., Cleveland—American Stove Co., 1787 East 40th St., awarded the contract for the construction of a 1 story 40 x 126 ft. addition to factory at 1787 East 40th St. Estimated cost $40,000.

Ohio, Cleveland—J. F. Bontempo, 308 Euclid Ave., Archt., is receiving bids for the construction of a 1-story, 140 x 200 ft. commercial and garage building on Euclid & Wymore Aves., for The Cleveland Properties Co., c/o R. M. DeFasselle. Estimated cost $150,000.

Pa., Philadelphia—U. S. Pencil Co., J. T. Furst, 60th and Baltimore Ave., having plans prepared for the construction of a 2 story, 218 x 60 ft. office and factory building on Woodland Ave. near 60th St. Estimated cost $75,000.

Pa., Pittsburgh—Fleming Tank Co., 3115 Liberty Ave., awarded the contract for the construction of a 1 story 96 x 100 ft. factory at 3954-56th St., and Penn. Ave. Estimated cost $40,000.

Pa., Pittsburgh—Gem Mfg. Co. (oil cans, oilers, etc.) awarded the contract for the construction of a 1 story addition to manufacturing plant and warehouse.

Pa., Union City—Eastman Mfg. Co., (dolls furniture) plans the construction of a 2 story addition to plant. Estimated cost $50,000. Private plans.

Tex., Houston—Kier-Nickels Garage Co., Louisiana & Texas Aves., awarded the contract for the construction of a 3-story garage. Estimated cost $300,000.

Wash., Seattle—H. Thomas, Arcade Bldg., Archt., will soon receive bids for the construction of a 3-story, 111 x 160 ft. store and garage for Inter-Avenue Bldg. Co., c/o Archt. Estimated cost $150,000.